This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

Valuable Medical Works

DA COSTA'S MEDICAL DIAGNOSIS.

MEDICAL DIAGNOSIS, with Special Reference to Practical Medicine. A G
Knowledge and Discrimination of Diseases. By J. M. DA COSTA, M.D., Lecture
Medicine, and Physician to the Philadelphia Hospital; Fellow of the College o
of Philadelphia, &c. &c. Illustrated with Numerous Engravings. 1 vol. 8vo.

From the AMERICAN JOURNAL OF MEDICAL | *From the* BOSTON MEDICAL AN

LANE

SEAL OF THE LELAND STANFORD JUNIOR UNIVERSITY

SEMPER VIRENS

1885

MEDICAL LIBRARY

LEVI COOPER LANE FUND

ance. It embodies most of the *science* of our profession. No practising physician should be without this book."

From the CHICAGO MEDICAL JOURNAL.

"We have no hesitation in saying that the author in producing this work has conferred a real benefit upon the profession, and that no medical library is complete which does not contain a copy."

From the PACIFIC MEDICAL AND SURGICAL JOURNAL.

"In the book of Dr. Da Costa the knowledge and discrimination of diseases are exposed in a clear and masterly manner. It is a manual that ought to be thoroughly studied by every student, not only at home, but at the bedside of patients in the clinical wards, as they do their text-book on anatomy in the dissecting-room. By so doing they would be more benefited than by the perusal of a dozen ordinary books on practice."

of inexperience—would be sav
sional reputation not placed
Even older practitioners will fin
of medical diagnosis of great
symptom is so completely ana
diagnosis of each case rendered
it is almost impossible for any
dent of the work to fall into er

From the MEDICAL AND SURGIC

"After looking it over gene
mining some parts carefully, w
to express the opinion that it is
merit, exhibiting a close acq
only with the philosophy of di
ral, but a familiarity with th
dences of the derangements
organs and functions, indicativ
perience and accurate study. T
illustrations of the anatomica
give rise to various signs of
heart, lungs, &c. are well draw
facilitate the explanation of t

E

Reinhardt

UTICS,

GY

ICA.

D.,

COLLEGE OF PHYSICIANS
TICE OF MEDICINE
S OF THE

A TREATISE

ON

THERAPEUTICS,

AND

PHARMACOLOGY

OR

MATERIA MEDICA.

BY

GEORGE B. WOOD, M.D.,

PRESIDENT OF THE AMERICAN PHILOSOPHICAL SOCIETY; PRESIDENT OF THE COLLEGE OF PHYSICIANS
OF PHILADELPHIA; EMERITUS PROFESSOR OF THE THEORY AND PRACTICE OF MEDICINE
IN THE UNIVERSITY OF PENNSYLVANIA; ONE OF THE AUTHORS OF THE
UNITED STATES DISPENSATORY; AUTHOR OF A TREATISE
ON THE PRACTICE OF MEDICINE, ETC. ETC.

Third Edition.

IN TWO VOLUMES.
VOL. I.

PHILADELPHIA:
J. B. LIPPINCOTT & CO.
1868.

Entered, according to the Act of Congress, in the year 1867, by
GEORGE B. WOOD, M.D.,
In the Clerk's Office of the District Court of the United States in and for the Eastern District of Pennsylvania.

LANE LIBRARY

W 89
v. 1
1868

TO

MY DEAR FRIEND,

FRANKLIN BACHE, M.D.,

PROFESSOR OF CHEMISTRY

IN THE

JEFFERSON MEDICAL COLLEGE OF PHILADELPHIA;

LATE PRESIDENT

OF THE

AMERICAN PHILOSOPHICAL SOCIETY;

MY PARTNER IN MUCH LABOUR;

MY COMPANION IN MANY SOCIAL HOURS;

WHOM,

IN THE COURSE OF AN INTIMATE ACQUAINTANCE OF MORE THAN THIRTY YEARS,

I HAVE NEVER KNOWN

TO DO AN UNJUST ACT, OR CHERISH AN UNJUST THOUGHT;

THE ACCURATE MAN OF SCIENCE;

THE SKILFUL TEACHER;

THE UPRIGHT AND HONOURABLE MAN;

AND,

IN ALL POINTS, THE GENTLEMAN,

I Inscribe this Work,

IN TESTIMONY OF

MY PROFOUND ESTEEM AND SINCERE AFFECTION.

GEO. B. WOOD.

PHILADELPHIA, AUGUST, 1856.

1009

PREFACE

TO THE FIRST EDITION.

THE work now offered to the medical public, while it aims to present whatever in Therapeutics and Pharmacology is directly and practically important to the physician, is intended also to be an exponent specially of what the author himself knows and believes on the subjects of which it treats. Its value, therefore, must depend greatly on the opportunities which he has possessed of acquiring knowledge, and forming just views upon these subjects; and upon this point, consequently, they for whom the work is intended have a right to be informed.

Almost from the commencement of his professional life, the author has given peculiar attention to this branch of medical knowledge. For a period of about thirty years, before 1850, when he was transferred to the professorship which he now occupies, he was engaged in teaching Materia Medica, first as a private lecturer, and afterwards successively in the Philadelphia College of Pharmacy, and the University of Pennsylvania. His position, therefore, rendered constant investigation into the properties, effects, and uses of remedies necessary, in order at once to do justice to his pupils, and avoid discredit to himself. Most of those whom he now addresses are probably aware that he is one of the authors of the U. S. Dispensatory. To provide the original materials for his portion of that work, and to gather from time to time the knowledge requisite for its maintenance upon a level with the progressive condition of medical science, unremitting diligence was essential in prosecuting inquiry and investigation in the whole field of Pharmacology. In addition to the ordinary professional opportunities, he has, for about twenty years, held the office of one of the physicians of the Pennsylvania Hospital, which has given him facilities for testing the value of remedies greater than any amount of private practice could afford. Few persons have had greater advantages or stronger inducements than himself for acquiring the knowledge requisite for the production of a work of this kind. Of the extent to which he has availed himself of these opportunities, and his ability to make a proper use of them, the reader will form his own opinion, either from what he may find in this Treatise, or from what he may know of former works of the author.

In preparing the present work for the press, the author claims to have been actuated, in part at least, by motives higher than those of personal credit, or pecuniary advantage. Though he pretends to no insensibility to these ordinary influences, he believes that he is obeying a call of duty in laying before the profession those results of his research, experience, and reflection upon the subject of Therapeutics, which have heretofore been confined to the narrower limits of classes of medical students. His former lectures constitute the chief substance of the present Treatise, though considerably extended, and much elaborated. Perhaps he may be laying himself open to a charge of overweening self-estimation, in supposing that he can add to the existing mass of knowledge, or improve existing views in this department of medicine, in a degree which may justify the publication of a book like the present; but he is unwilling to leave the world without giving some degree of permanency to what he has so long taught, and consoles himself with the consideration that, should the work prove of less value to the profession than he ventures to hope or anticipate, it is not likely to do serious injury, and, at the worst, will be merely superfluous.

A few words of explanation may be necessary to a correct appreciation of the character of the Treatise. Though aiming at considerable fulness in all that concerns the effects of remedies, the nature of their operation, and their therapeutic application, it has no pretension whatever to be considered as a complete exposition of the Materia Medica, properly so called. Of the natural and commercial history, the sensible and chemical properties, and the pharmaceutical preparation of drugs, the author has endeavoured to select such parts as are of direct and immediate interest to the medical practitioner, and without a knowledge of which, he can scarcely be said to be prepared to enter upon the duties of his profession. All, therefore, that is said on these points may be considered as, in the opinion of the author, requiring the particular notice of the student. He has given much attention to this branch of the subject, in reference both to the general value and the accuracy of the facts stated; having, in many doubtful instances, practically verified their correctness. In the prosecution of investigations for this purpose, he has pleasure in acknowledging his indebtedness to Professor William Procter, Jr., who has, at his suggestion and request, performed many experiments in relation to the chemical properties, reactions, and incompatibilities of the medicines described.

The work will not be found rich in formulas. Nothing would have been easier than to attach numbers of prescriptions to every important medicine described. But the author has always considered that a multiplication of these precise combinations is productive of much more injury than good. It leads to an indolent reliance on mere authority, by sparing the trouble of thought; and greatly conduces to an empirical and routine practice, neither creditable to the physician, nor profitable to the patient. The author has preferably sought to give principles, by which the physician himself may construct formulas, suitable to each special occasion. He has endeavoured to point out, in reference to each medicine, the peculiar circumstances which render its use appropriate, and the modifications in dose or form which it must undergo, to adapt it to the varying circumstances of different cases, or of the same case at different times. He has also called attention to the medicines with which, in each special case, it may be appropriately combined, to aid or qualify its operation. With this knowledge, and that of the pathological condition to be corrected, the educated physician will be qualified to form much more appropriate associations or combinations of medicines, and to regulate much more correctly the proportions of the several ingredients in correspondence with the indications, than any formulary can possibly do for him; nor can any medical man be considered as duly instructed, until he is capable of constructing such formulas for his own purposes.

To any one familiar with the author's Treatise on the Practice of Medicine, it will be obvious, in the perusal of the present work, that the same great principles of pathology pervade both, and constitute in fact the very basis of whatever belongs to the general subject of Therapeutics in the latter. The author has avoided an elaborate representation of these principles on the present occasion; as it would render necessary a repetition of much that is contained in his observations on general pathology in the former Treatise, to which, therefore, he would respectfully invite the attention of the reader, if desirous of information on the subject.

Finally, it is proper to state that, on a comparison of this work with the Treatise on the Practice, upon the one hand, and the U. S. Dispensatory on the other, there will be found not a little that is common to it and one or both of the others; but this overlapping, at the borders, of Treatises on closely allied subjects is absolutely essential to a full and consistent view of each, and is nothing more than is found in all conterminous sciences, not only in the great complex science of medicine, but throughout the whole circle of human knowledge.

This is probably the last professional Treatise of the author; as, with its publication, he will have exhausted what he has had to communicate in those departments of medicine to which he has given a special attention; and advancing years warn him that the time is fast approaching, when a failure of faculties, or the termination of life, will render labour in any new field impracticable. He asks for it only the same kindly consideration which he has had occasion to acknowledge for his other works, and which has bound him to the profession by the strong ties of gratitude, in addition to those of duty and affection.

PHILADELPHIA, August, 1856.

PREFACE

TO THE THIRD EDITION.

In consequence of pressing engagements in the revision of his other works, which could not with propriety be postponed, the author has been compelled in some degree to neglect the present, which has now for several months been out of print. About seven years have elapsed since the second edition was given to the public; and, as this period has been one of extraordinary activity in the cultivation of medicine, it will be readily perceived that much labor was necessary, on the part of the author, to bring the work fully up to the level of the present time. For nearly a year, with a short intermission rendered unavoidable by family affliction and his own impaired health, he has devoted most of his time to this object; and the reader will perceive, by the additions made to the Treatise, and the numerous modifications necessary to keep pace with the advance of the science and the change of opinion, that the task of revision has been no sinecure. Besides many of minor importance, the following remedial substances have been treated of, and some at considerable length; to wit, *coca, nitrous oxide, antimoniated hydrogen, gelsemium, calabar bean, bromine and its preparations, lithia and its carbonate and citrate, ozone, peroxide of hydrogen, permanganate of potassa*, and *sulphurous acid and the sulphites* with *carbolic acid* in their antizymotic relations. The progress of the science has rendered advisable the formation of two new classes, in order propperly to arrange several substances of peculiar powers; one embracing the disinfectants, which now hold an important place among the means of encountering disease; and the other named antizymotics, because endowed with extraordinary powers in arresting fermentative processes, which are recognized as exercising a most noxious influence in the causation of disease. The size of the type used in the former editions has been so much reduced in the present, as to enable the quantity of matter contained in each page to be increased at least one-tenth; and yet, to accommodate the new material, it has been found necessary to add considerably to the bulk of the book. The subjects of subcutaneous injection, and of the introduction of liquids into the air-passages by bringing them to the state of fine spray, which are now for the first time fully considered in this Treatise, involve so large a number of substances in their practical application, that a constant watchfulness was necessary, in the revision, not to allow important medicines to pass unnoticed in this relation. The author is not aware that any topic, having a direct bearing upon the subject of the work, has been neglected in preparing it for the press; and he thinks he may justly say that, whatever may have been the merits of the former editions, as exhibiting the condition of the Materia Medica at the periods respectively when they were issued, the present will not be found to have deteriorated as representative of the existing state of the science. The author wishes once more to repeat the assurance of his warm interest in the advancement of the profession and its prosperity in all respects, and of his grateful feelings towards its members personally for the kindness which his labours have always received at their hands.

PHILADELPHIA, Oct. 15th, 1867.

There are a few abbreviations used throughout the work which require explanation. The letters U. S., attached to a medicinal name or process, are to be understood as referring to the authority of the existing United States Pharmacopœia; *Br.*, to that of the first British Pharmacopœia published in 1864; and *Lond.*, *Ed.*, *Dub.*, to that of the last Pharmacopœias published by the London, Edinburgh, and Dublin Colleges respectively, but now superseded by the British.

In an Appendix will be found tables showing the differences between the British Pharmacopœia recently published, and the first edition of that work, published in 1864, which has been recognized throughout this Treatise as the British standard.

The reader is requested to supply two omissions, from inadvertence, in the following pages; one, of *Moschus Moschiferus*, the name of the animal described as furnishing musk (*vol.* i. *p.* 590), and the second, of *Cephaëlis Ipecacuanha*, as the botanical title of the ipecacuanha plant (*vol.* ii. *p.* 465).

TABLE OF CONTENTS.

PART I.

GENERAL THERAPEUTICS AND PHARMACOLOGY.

CHAPTER I.

OPERATION OF MEDICINES.

Section I.

PRIMARY OPERATION OF MEDICINES.

Subsection I.

PRIMARY OPERATION THROUGH THE CIRCULATION, OR BY ABSORPTION.

Subsection II.

PRIMARY OPERATION THROUGH THE NERVES.

Subsection III.

PRIMARY LOCAL OPERATION.

Subsection IV.

MODES OF PRIMARY OPERATION.

1. Mechanical or Physical.—2. Chemical.—3. Physiological, Vital, or Dynamic.

Section II.

SECONDARY OPERATION OF MEDICINES.

1. By Depression after Excitement.—2. By Reaction following Depression.—3. Through Dependence of Function.—4. Through Sympathy or Nervous Transmission.—5. Through Revulsion or Derivation.—6. Through the Repair of Injuries.—7. Through the Removal of the Cause.

CHAPTER II.

EFFECTS OF MEDICINES.

Section I.

ESTIMATION OF THEIR POWERS OR EFFECTS.

1. Through their Sensible Properties.—2. Through their Chemical Relations.—3. Through their Botanical Affinities.—4. By Experiments and Observations on the Lower Animals.—5. By Observations of their Effects on Man.

Section II.

WHETHER THE EFFECTS ARE ORGANIC OR FUNCTIONAL.

Section III.

CHARACTERISTIC EFFECTS OF MEDICINES.

Section IV.

INFLUENCES MODIFYING THE EFFECTS OF MEDICINES.

1. Age. — 2. Sex. — 3. Temperament. — 4. Idiosyncrasy. — 5. Disease. — 6. Climate. — 7. Habit. — 8. Modes of Living. — 9. Mental Action.

CHAPTER III.

APPLICATION OF MEDICINES.

Section I.

MODES OF THERAPEUTIC ACTION, OR THERAPEUTIC PROCESSES.

1. Depletion. — 2. Repletion. — 3. Dilution. — 4. Elimination. — 5. Stimulation. — 6. Sedation or Depression. — 7. Revulsion, Derivation, and Counter-irritation. — 8. Supersession or Substitution. — 9. Alteration. — 10. Contra-causation. — 11. Chemical Influence. — 12. Mechanical Influence.

Section II.

FORMS IN WHICH MEDICINES ARE USED.

Subsection I.

SOLID FORMS.

1. Powders. — 2 Electuaries. — 3. Conserves. — 4. Pills. — 5. Lozenges. — 6. Cataplasms. — 7. Ointments, Cerates, and Plasters. — 8. Extracts.

Subsection II.

LIQUID FORMS.

1. Mixtures. — 2. Solutions. — 3. Waters. — 4. Infusions. — 5. Decoctions. — 6. Tinctures. — 7. Spirits. — 8. Wines. — 9. Vinegars — 10. Syrups. — 11. Honeys. — 12. Oxymels. — 13. Fluid Extracts. — 14. Glycerates or Glyceroles. — 15. Spray.

Subsection III.

IN THE AERIFORM STATE.

Section III.

PARTS TO WHICH MEDICINES ARE APPLIED, AND MODES OF APPLICATION.

Subsection I.

TO THE ALIMENTARY CANAL.

1. To the Stomach. — 2. To the Rectum.

Subsection II.

TO THE EXTERNAL SURFACE OF THE BODY.

1. By Contact with the Sound Skin. — 2. By Friction. — 3. Endermic Application.

Subsection III.

TO THE LUNGS.

1. By Inhalation. — 2. Use of Liquids in the form of Spray.

Subsection IV.

TO THE SUBCUTANEOUS AREOLAR TISSUE.

Hypodermic or Subcutaneous Injection.

Subsection V.

TO VARIOUS OTHER SURFACES.

1. The Eyes. — 2. Nostrils. — 3. Mouth. — 4. Blood-vessels.

CHAPTER IV.

CLASSIFICATION OF MEDICINES.

1. Uses of Classification. — 2. Plan of Classification.

PART II.

SPECIAL THERAPEUTICS AND PHARMACOLOGY.

Division I.

SYSTEMIC REMEDIES.

Subdivision I.

GENERAL REMEDIES.

CHAPTER I.

GENERAL STIMULANTS.

Section I.

PERMANENT STIMULANTS.

CLASS I.

Astringents.

I. General Observations, including the consideration of *Cold* as an Astringent.

II. VEGETABLE ASTRINGENTS. — *Galls* with *Tannic* and *Gallic Acids; Oak Barks; Kino; Catechu* with *Gambir; Rhatany; Logwood; Cranesbill; Blackberry and Dewberry Roots; Uva Ursi; Pipsissewa; Red Roses; Tormentil; Water Avens; Hardhack; Pomegranate Rind; Bistort; Alum Root; Marsh Rosemary;* and *Persimmon.*

III. MINERAL ASTRINGENTS. — *Alum; Lead and its Preparations; Sulphates of Iron, Zinc,* and *Copper,* and other salts of the same metals; and various other mineral substances, as *Nitrate of Silver, Corrosive Sublimate, Sulphuric Acid,* and *Lime* with its *Carbonate.*

CLASS II.

Tonics.

I. General Observations, including the consideration of *Diet*, *Exercise*, *Pure Air*, *Mental Influence*, *Travelling*, *Cold*, and *Transfusion of Blood*, as tonic agencies.

II. Tonics of Animal Origin, of which only *Cod-liver Oil* is considered.

III. Vegetable Tonics, subdivided into, 1. *Pure or Simple Bitters*, comprising *Quassia*, *Simaruba*, *Gentian*, *Star-grass* or *Aletris*, *Chiretta*, *American and European Centaury*, *American Columbo*, *Columbo*, *Goldthread*, and *Yellow Root;* 2. *Peculiar Bitters*, comprising *Peruvian Bark* with *Quinia* and its other preparations, *Nectandra*, *Dogwood*, *Willow Bark*, *Hydrastis*, *Barberry*, *Hops*, *Wild Cherry Bark*, *Chamomile*, *German Chamomile* or *Matricaria*, *Eupatorium*, *Serpentaria*, *Arnica*, *Myrrh*, *Angustura Bark*, *Cascarilla*, *Contrayerva*, *Wormwood*, *Tansy*, *Horehound*, *Catnep*, and *Yarrow;* and 3. *Aromatics*, comprising *Orange-peel*, *Lemon-peel*, *Bergamot Oil*, *Cinnamon*, *Canella*, *Winter's Bark*, *Cloves*, *Nutmeg*, *Black Pepper*, *Cubebs*. *Matico*, *Pimento*, *Cardamom*, *Fennel-seed*, *Caraway*, *Coriander*, *Anise*, *Star Aniseed*, *Dill*, *Lavender*, *Rosemary*, *Peppermint*, *Spearmint*, *European and American Pennyroyal*, *Horsemint*, *Marjoram*, *Thyme*, *Sage*, *Balm*, *Partridge Berry*, *Ginger*, *Zedoary*, *Turmeric*, *Calamus*, *Wild Ginger*, and *Vanilla*.

IV. Mineral Tonics, subdivided into, 1. *those acting specially on the Stomach and Bowels*, to which belong the *Mineral Acids*, comprising the *Sulphuric*, *Nitric*, *Muriatic*, *Nitromuriatic*, *Phosphoric*, and *Carbonic Acids;* 2. *those operating on the System generally through its Vital Properties*, comprising the *Preparations of Silver*, *Copper*, *Zinc*, and *Bismuth;* and 3. *the Reconstructive Tonics*, to which belong *Iron* and its *Preparations*.

Section II.

DIFFUSIBLE STIMULANTS.

1. General Observations. — 2. Division of these Stimulants into the Arterial, Nervous, Cerebral, and Spinal. — 3. Consideration of *Heat* and *Electricity* as Diffusible Stimulants.

CLASS I.

Arterial Stimulants.

1. *Cayenne Pepper*. — 2. *Oil of Turpentine*. — 3. *Carbonate of Ammonia* with the *Water*, *Spirit*, and *Aromatic Spirit of Ammonia*. — 4. *Phosphorus*.

CLASS II.

Nervous Stimulants.

I. General Observations, with the consideration of *Emotional* and *Sensational Influences*, including those of *Cold* and *Electricity* as Nervous Stimulants.

II. Medicinal Nervous Stimulants — *Musk*, *Castor*, *Assafetida*, *Sagapenum*, *Galbanum*, *Ammoniac*, *Valerian*, *Valerianate of Ammonia*, *Garlic*, *Coffee*, *Tea*, *Rectified Oil of Amber*, *Dracontium*, *Cypripedium*, *Saffron*, *Cochineal*, and *Coca*.

CLASS III.

Cerebral Stimulants.

I. General Observations.

II. Individual Cerebral Stimulants—*Alcohol* and its *Preparations; Ether; Nitrous Oxide; Camphor; Opium* and its *Preparations*, including *Morphia, Codeia*, and *Narcotina; Hemp of India; Hyoscyamus; Belladonna* with *Atropia*, and *Stramonium.*

CLASS IV.

Spinal Stimulants.

Nux Vomica and *Bean of St. Ignatius*, with *Strychnia* and *Brucia.*

CHAPTER II.

GENERAL SEDATIVES.

General Observations, with the consideration of *Cold, Water*, and *Depletion, direct* and *indirect*, as sedative agents.

CLASS I.

Arterial Sedatives, or Refrigerants.

1. Preparations of *Antimony*, including *Tartar Emetic, Oxysulphuret of Antimony, Oxide of Antimony*, and *Antimoniated Hydrogen.*—2. *Refrigerant Salts*, with a particular account of *Nitrate of Potassa.*—3. *Vegetable Acids*, comprising the *Citric, Acetic*, and *Tartaric Acids.*

CLASS II.

Nervous Sedatives.

1. *Digitalis* with *digitalin.*—2. *Tobacco.*—3. *Lobelia.*—4. *Aconite* with *Aconitia.*—5. *American Hellebore.*—6. *Veratria*, with *White Hellebore* and *Cevadilla.*—7. *Black Snakeroot* or *Cimicifuga.*—8. *Gelsemium.*

CLASS III.

Cerebral Sedatives.

I. General Observations, with the consideration of *Mental Influence*, including *Artificial Somnambulism*, as a Cerebral Sedative.

II. Medicinal Cerebral Sedatives—1. *Hydrocyanic Acid*, with *Bitter Almonds, Cherry Laurel Leaves*, and *Cyanide of Potassium;* 2. *Chloroform;* 3. *Conium* or *Hemlock;* and 4. *Lactucarium.*

CLASS IV.

Spinal Sedatives.

Calabar Bean.

CHAPTER III.

ALTERATIVES.

I. General Observations.

II. *Mercury* and *its Preparations.*

III. *Preparations of Arsenic.*

IV. *Iodine* and *its Preparations.*

V. *Chlorine* and *its Preparations*, comprising *Gaseous Chlorine, Chlorine Water, Chlorinated Lime, Solution of Chlorinated Soda, Solution of Chloride of Calcium, Solution of Chloride of Barium, Chloride of Sodium* or *Common Salt, Muriate of Ammonia*, and *Chlorate of Potassa.*

VI. *Bromine* and *its Preparations*, including *Bromide of Potassium* and *Bromide of Ammonium.*
VII. *Sulphur* and *its Preparations — Washed Sulphur* and *Precipitated Sulphur, Sulphurous Acid, Hydrosulphuric Acid,* and *Sulphuret of Potassium.*
VIII. Vegetable Alteratives — *Colchicum, Sarsaparilla, Guaiacum, Mezereon, Sassafras, Bittersweet* or *Dulcamara, Stillingia, False Sarsaparilla,* and *Hemidesmus.*

Subdivision II.

LOCAL REMEDIES.

CHAPTER I.

LOCAL REMEDIES AFFECTING THE FUNCTIONS.

CLASS I.

Emetics.

I. General Observations on Emetics, and *Auxiliary Emetic Measures.*
II. Vegetable Emetics — *Ipecacuanha, Gillenia, Bloodroot, Euphorbia Ipecacuanha* and *Corollata, Lobelia, Mustard, Squill,* and *Tobacco.*
III. Mineral Emetics — *Tartar Emetic, Sulphate of Zinc, Sulphate of Copper,* and *Turpeth Mineral.*

CLASS II.

Cathartics.

I. General Observations, with the division into Laxatives, Purges, and Drastic Purges.
II. Laxatives, subdivided into, 1. those which operate physically, as *White Mustard Seed, Wheat Bran,* and *Metallic Mercury;* and 2. those operating dynamically, as *Sugar, Saccharine* and *Acidulous Fruits, Manna,* and *Cassia Fistula,* among vegetable substances, and *Sulphur, Carbonate of Magnesia,* and *Magnesia* among the mineral.
III. Purges, subdivided into, 1. the Vegetable, which comprise *Castor Oil, Rhubarb, Butternut, Aloes, Senna, American Senna, Jalap,* and *May-apple* or *Podophyllum;* 2. the Saline, to which belong, *Sulphate of Magnesia, Sulphate of Soda, Sulphate of Potassa, Bitartrate of Potassa, Tartrate of Potassa and Soda, Tartrate of Potassa, Phosphate of Soda,* and *Citrate of Magnesia;* and 3. the Mercurial, of which *Calomel* or the *Mild Chloride of Mercury* is the only one considered.
IV. Drastics or Drastic Purges — *Scammony, Colocynth, Black Hellebore, Gamboge, Elaterium,* and *Croton Oil.*
V. *Cathartic Enemata.*

CLASS III.

Diuretics.

I. General Observations, with the consideration of various diuretic agencies, as *Cold, Vascular Fulness, Arterial Stimulation,* and *Mental Emotion.*
II. Individual Non-Stimulating Vegetable Diuretics — comprising *Digitalis, Squill, Broom, Juniper, Parsley Root, Dandelion, Fleabane, Carrot Seed,* etc.

III. Refrigerant Diuretics — *Bitartrate of Potassa* or *Cream of Tartar*, *Nitrate of Potassa* or *Nitre*, *Acetate of Potassa*, and the *Carbonates* and *Bicarbonates of Potassa and Soda*, to which may be added *Spirit of Nitric Ether* or *Sweet Spirit of Nitre*.

IV. Stimulating Diuretics — *Turpentine* with its *volatile oil*, *Tar*, *Creasote*, *Copaiba*, *Buchu*, *Pareira Brava*, *Cantharides*, *Horse-radish*, *Mustard*, and *Garlic*.

CLASS IV.

Diaphoretics or Sudorifics.

I. General Observations, with the consideration of *Heat* and *Water* as diaphoretic agents.

II. Nauseating Diaphoretics — *Tartar Emetic*, *Ipecacuanha*, the *Powder of Ipecacuanha and Opium* or *Dover's Powder*, etc.

III. Refrigerant Diaphoretics — *Citrate of Potassa* in the forms of *Neutral Mixture* and *Effervescing Draught*, *Solution of Acetate of Ammonia*, *Nitrate of Potassa*, and *Spirit of Nitrous Ether* or *Sweet Spirit of Nitre*.

IV. Stimulant Diaphoretics — *Sarsaparilla*, *Guaiacum*, *Mezereon*, *Sassafras*, *Prickly Ash*, and *Serpentaria*, with *Asclepias* or *Pleurisy Root*, though not stimulating.

CLASS V.

Expectorants.

I. General Observations.

II. Nauseating or Depressing Expectorants — *Ipecacuanha*, *Tartar Emetic*, and other nauseating Emetics.

III. Stimulant Expectorants — *Squill*, *Seneka*, *Ammoniac*, *Assafetida*, *Garlic*, *Balsam of Tolu*, *Balsam of Peru*, *Benzoin* with *Benzoic Acid*, *Storax*, *Copaiba*, the *Turpentines*, *Tar*, *Creasote*, and *Resin*.

CLASS VI.

Cholagogues.

General Observations, and reference to the particular articles of the Class, described under other heads.

CLASS VII.

Emmenagogues.

I. General Observations.

II. Tonic Emmenagogues — *Iron*, *Myrrh*, and *Tansy*.

III. Purgative Emmenagogues — *Aloes* and *Black Hellebore*.

IV. Stimulant Diuretics with Emmenagogue properties — *Cantharides*.

V. Special Emmenagogues — *Savine*, *Rue*, *Seneka*, *Guaiac*, etc.

CLASS VIII.

Uterine Motor-Stimulants.

I. General Observations.

II. Individual members of the Class — *Ergot*, and, with less certainty, *Extract of Hemp*, *Tansy*, *Root of the Cotton Plant*, etc.

CLASS IX.

Sialagogues.

General Observations, and reference to special articles described elsewhere, besides *Pellitory* particularly described.

CLASS X.

Errhines.

I. General Observations.

II. Particular Errhines—*Aromatic Powders*, *Tobacco*, *Asarabacca*, *White Hellebore*, *Euphorbium*, and *Turpeth Mineral.*

CHAPTER II.

LOCAL REMEDIES AFFECTING THE ORGANIZATION.

CLASS I.

Epispastics.

I. General Observations on Blisters, and reference to *Heat* as a vesicating agent.

II. Particular Epispastics—*Cantharides*, and *Stronger Water of Ammonia.*

CLASS II.

Rubefacients.

I. General Observations, and consideration of *Heat*, *Friction*, *Acupuncture*, and *Electricity*, as rubefacients.

II. Simple Inflammatory Rubefacients—*Mustard*, *Cayenne Pepper*, *Oil of Turpentine*, *Burgundy Pitch*, *Canada Pitch*, *Tar*, *Creasote*, *Resin*, various *Aromatics* and *Gum-resins*, *Acrid Substances*, *Ranunculi*, *Common Nettle*, and *Preparations of Ammonia.*

III. Pustulating Rubefacients—*Tartar Emetic* and *Croton Oil.*

CLASS III.

Escharotics.

I. General Observations, with the consideration of *Heat* as an Escharotic, and specially of the *Actual Cautery*, *Moxa*, and *Galvanic Cauterization.*

II. Particular Escharotics—*Potassa*, *Potassa with Lime*, *Nitrate of Silver*, *Sulphate of Copper*, *Arsenious Acid*, *Chloride of Zinc*, *Sulphate of Zinc*, *Corrosive Sublimate*, *Solution of Nitrate of Mercury*, *Sulphate* and *Iodide of Cadmium*, *Dried Alum*, and *Sulphuric*, *Nitric*, *Muriatic*, and *Chromic Acids.*

CHAPTER III.

LOCAL REMEDIES ACTING MECHANICALLY.

CLASS I.

Diluents.

General Observations, with reference to *Water* as the only true Diluent.

CLASS II.

Demulcents.

I. General Observations, and division into the Mucilaginous, Saccharine, and Amylaceous Demulcents.

II. Mucilaginous Demulcents — *Gum Arabic, Gum Mesquite, Tragacanth, Flaxseed, Quince Seed, Slippery Elm Bark, Sassafras Pith, Benne Leaves*, and *Marshmallow.*

III. Saccharine Demulcents — *Sugar, Molasses, Liquorice* and *Liquorice Root*, and *Glycerin.*

IV. Amylaceous Demulcents — *Wheat Starch, Arrow-root* or *Maranta, Sago, Tapioca, Pearl Barley, Iceland Moss, Irish Moss* or *Carrageen, Sweet Almonds*, and *Wheat Bran.*

CLASS III.

Emollients.

I. General Observations, and reference to *Water* as the main emollient agent.

II. Particular Emollients — *Bread and Milk, Flaxseed Meal, Slippery Elm Bark, Marshmallow Root, Oatmeal, Indian Meal, Boiled Potatoes, Carrots*, etc.

CLASS IV.

Protectives.

I. General Observations, and division of the Protectives into the Direct and Indirect.

II. Direct Protectives — *Olive* and *Almond Oil, Lard, Suet, Spermaceti, Wax, Lead Plaster, Resin Plaster, Soap Plaster, Collodion, Caoutchouc*, and *Gutta Percha.*

III. Indirect Protectives — *Nitrate of Silver, Iodine*, and *Creasote.*

Division II.

NON-SYSTEMIC REMEDIES.

CLASS I.

Antacids.

I. General Observations on the Antacids, and consideration of the dynamic effects of the Alkalies.

II. Particular Antacids — *Solution of Potassa; Carbonate* and *Bicarbonate of Potassa; Carbonate* and *Bicarbonate of Soda; Borax; Lithia* with its *Carbonate* and *Citrate; Water, Spirit, Aromatic Spirit*, and *Carbonate of Ammonia; Lime-water; Precipitated Carbonate of Lime; Prepared Chalk* and *Prepared Oyster-shell;* and *Magnesia* with its *Carbonate* and *Bicarbonate.*

CLASS II.

Absorbents.

I. General Observations.

II. Particular Absorbents — *Charcoal* and *Animal Charcoal.*

CLASS III.

Solvents.

I. General Observations.

II. Particular Solvents — *Gastric Juice, Rennet, Pepsin, Lactic Acid*, and *Yeast.*

CLASS IV.

Disinfectants.

I. General Observations.

II. Agents Operating Mechanically — *Cleanliness*, *Ventilation*, *Charcoal*, *Lime*.

III. Agents Operating Chemically — 1. Oxidizing Disinfectants, comprising *Ozone*, *Chlorine*, *Bromine*, *Iodine*, *Permanganate of Potassa*, *Peroxide of Hydrogen*, and *Mineral Acids* with their *Metallic Salts*; 2. Deoxidizing Disinfectants, comprising *Sulphurous Acid* and the *Sulphites*, *Nitric Oxide*, *Sulphate of Protoxide of Iron*, and *Ammonia*; 3. Neutralizing Disinfectants, including *Carbolic Acid* with analogous substances, *Chloride of Zinc*, and *Chloride of Iron*.

CLASS V.

Parasiticides.

General Observations, and Division into two SUB-CLASSES, viz.;

SUB-CLASS I.

Anthelmintics.

1. General Observations.
2. Particular Anthelmintics — *Pinkroot* or *Spigelia*, *Wormseed*, *Azedarach*, *European Wormseed* with *Santonin*, *Cowhage*, *Male Fern*, *Pomegranate Root*, *Oil of Turpentine*, *Koosso*, *Pumpkin Seed*, *Calomel*, *Kameela*, etc.

SUB-CLASS II.

Antizymotics.

1. General Observations.
2. Particular Antizymotics — *Sulphur*, *Sulphurous Acid*, the *Sulphites* and *Hyposulphites*, *Carbolic* and *Cresylic Acids* and *Creasote*, *Tar* with *Impure Pyroligneous Acid*, *Smoke*, *Petroleum*, and *Saccharine Solutions*.

A TREATISE

ON

THERAPEUTICS

AND

PHARMACOLOGY.

INTRODUCTORY OBSERVATIONS.

Pharmacology, or the science of **Materia Medica**, treats of *medicines* in all their relations: **Therapeutics**, of *remedies* in general, and their application to the cure and alleviation of disease.

Medicines are substances capable of producing, as an ordinary result, and by their own inherent power, changes in the healthy vital functions, which render them available for curative purposes. All these conditions are essential. Medicines are substances, or, in other words, are material. Influences not material, though efficient in the cure of disease, are not medicines. Substances necessary for the support of life, such as food, drink, atmospheric air, solar heat and light, are capable, if unduly applied, of deranging the vital functions: but this is not their ordinary operation; and they do not, therefore, belong to the category now under consideration. Again, bodies which have no inherent power of disturbing the functions may be rendered noxious, or remedial, by some extraneous agency. Thus, the dagger which destroys life in the hands of the assassin, and the knife which saves it in the hands of the surgeon, are incapable alike of injurious or beneficial action, when merely placed in contact with the body without any foreign impulse. Such bodies are evidently not entitled to the rank of medicines. There are, moreover, many substances which have the inherent power of even violently disturbing the system when brought into connection with it, which, however, have not been proved to possess remedial properties, and are never employed in the treatment of disease. These may be poisons, but they are not medicines. It is thus seen that all the conditions stated in the definition are essential. There are, indeed, a few substances, usually denominated medicines, which do not strictly fulfil these conditions. Such are anthelmintics, which are not used to modify the functions of the human system, but to act on certain foreign bodies which happen to be contained within it. Such, too, are the antacids given to neutralize acid in the stomach and bowels. But it happens that most of these substances really have medicinal properties, which render them useful for other purposes; and, so far as they are employed merely as anthelmintics or antacids, they may be regarded not as medicines, but as simply ranking in the more general category of remedies.

Remedies are agents, or influences of any kind whatever, capable of being usefully employed in the treatment of disease. Of course all medicines may be remedies; but there are very many remedies which are not medicines. To constitute any agent a remedy, it is not even necessary that it should be material. It may be a process or action whether mental or physical, a state or condition, a change of circumstance, even a negative quality, or the absence or diminution of some positive agency. Thus, we may class with remedies not only medicines, and the various substances, which, though not strictly medicinal, are yet employed therapeutically, as water, heat, electricity, etc., but also such influences as blood-letting, abstinence, exercise, rest, position, change of residence, cold, darkness, mental emotion, and many others that might be mentioned.

Pharmacology, which as before stated treats of medicines in all their relations, including of course their application to the cure of disease, has nothing to do with remedies not medicinal; whereas Therapeutics, which treats of all remedies in their remedial capacity, leaves out of view the properties of medicines not essentially belonging to them as such; their natural and commercial history, for example, their sensible and chemical properties, and their various modes of officinal preparation. There is an advantage, therefore, in combining the two sciences in one treatise; as each supplies the deficiencies of the other, and both combined convey all desirable information in relation to the origin, qualities, and uses of remedies.

In the present treatise, however, though some notice will be taken of those branches of the subject peculiar to Pharmacology, yet, as the United States Dispensatory, in the preparation of which the author participated, is especially devoted to that science, and treats in sufficient detail of almost everything exclusively belonging to it, he proposes to devote a more particular attention to therapeutics, which is but partially treated of in the Dispensatory, and in many important points has been quite overlooked. Indeed, the work which he now submits to the medical public, may be looked on as, in some measure, supplementary to the U. S. Dispensatory, affording by its arrangement a convenient plan for the perusal and study of that work, supplying its therapeutical deficiencies, and noticing those relations and properties of medicines having no immediate connection with therapeutics, only so far as may be essential to the practical physician; reference being made to the Dispensatory for information of general or pharmaceutical interest, and for minute detail on all exclusively pharmacological points.

The work will consist of two parts. As there are many subjects, both in Therapeutics and Pharmacology, which are of a general nature, and cannot without inconvenience of arrangement, or the necessity for constant repetition, be considered in connection with special remedies, or even classes of remedies, it is proposed to treat of these preliminarily under the heading of *General Therapeutics and Pharmacology*, which will, therefore, constitute the first part of the work. The second part, much more extensive than the first, and forming, indeed, the main body of the treatise, will be devoted to the subordinate divisions and specialties of the two sciences, under the name of *Special Therapeutics and Pharmacology.*

PART I.

GENERAL THERAPEUTICS AND PHARMACOLOGY.

CHAPTER I.

Operation of Medicines.

The operation of medicines is either *primary* or *secondary;* the *primary* operation being that which results from their immediate influence on the system; the *secondary*, that which follows their original and characteristic impression, in consequence of certain physiological laws. Thus, purgation is the primary operation of a cathartic; derivation of blood from the head, with the attendant relief of any existing cerebral congestion, is a secondary operation, and a simple consequence of the first, just as the same result would follow an equal amount of intestinal irritation with diarrhœa from other causes.

SECTION I.

Primary Operation of Medicines.

One of three events must occur when a medicine is applied with effect to any part of the body. Either it must enter the circulation, and be carried with the blood throughout the system, acting upon such parts as may be susceptible to its influence; or the local impression, first produced by it, must be conveyed through nervous communication to the parts, more or less distant, in which its effects are to be displayed; or, finally, it must act exclusively in the vicinity of its application. Each of these modes of operation requires to be considered.

SUBSECTION I.

Primary Operation through the Circulation.—Absorption.

It was at one time thought by many that medicines never entered the circulation. The absorbents were supposed to afford the only avenue of foreign bodies into the system. Substances incapable of being assimilated to the blood, were believed to penetrate no further than the absorbent glands, which were so many sentinels placed to guard the system against the intrusion of noxious agents. This notion was purely theoretical; and, even at the time when it was most strenuously maintained, was opposed by known facts which prevented its universal adoption. Subsequent experiments and observations, extremely numerous, and diversified in almost every conceivable manner, have established the conclusion, beyond all possible doubt or cavil, that medicines are very frequently absorbed, and, entering the blood-vessels, are circulated with the blood throughout the body. The following proofs of this truth may be adduced.

1. When medicines are applied directly to any surface of the body, and produce their characteristic effects elsewhere, it may often be noticed that portions of them have disappeared, without any possibility of accounting for their disappearance except by their absorption, or at least their entrance into the system.

2. The sensible properties of the medicine, its odour, taste, and colour, are frequently perceptible, either unchanged, or somewhat modified, in the breath, the secretions, and even in the various solid tissues. The effect of garlic in diffusing its odour and taste is universally known; rhubarb gives to the urine the property of staining linen yellow; and madder not unfrequently imparts its red colour to the bones.

3. The peculiar medicinal or poisonous effects of certain substances are occasionally produced, by taking into the stomach the liquid secretions of individuals under the influence of these substances. Thus, medicines given to the mother not unfrequently operate on the suckling; and numerous other illustrations of a similar kind might be adduced.

4. Effects, produced by medicines in distant parts, may be prevented by ligatures around the blood-vessels proceeding from the part with which the medicine is brought into immediate contact.

5. In many instances, the characteristic effects of medicines, exhibited in the ordinary way, may be obtained by injecting them into the blood-vessels.

6. But the most irresistible evidence is that afforded by chemical investigation, which has in almost innumerable instances detected medicinal substances taken into the stomach, or applied to other parts of the body, not only in the perspiration, saliva, urine, and other secretions,

and in various solid tissues, but in the blood itself. Indeed, the list of substances, which have thus been proved to have been circulated through the system, is so large as to authorize the inference, that all medicines, capable of extending a direct action beyond the original surface of contact, may be absorbed, and carried with the blood to the part or organ which they affect.

It has been said that the effects of some medicines and poisons are so rapid, as to preclude the idea that they could have been absorbed, and conveyed to the seat of their action by the ordinary route of the circulation. But comparatively recent experiments, by proving the extreme rapidity with which the blood makes a complete circuit in the body, have invalidated that objection. Professor Hering, of Stuttgard, found that ferrocyanide of potassium, injected into the jugular vein of a horse, might be detected in the opposite jugular vein in a period of time varying from twenty to thirty seconds (*Zeitschrift für Physiologie*, iii. 122); and Dr. James Blake, formerly Professor of Anatomy in the Saint Louis University, has proved that "the time required for the blood to pass from the jugular vein, and to be circulated through the body, was, in the horse sixteen seconds, in the dog twelve seconds, in the fowl six seconds, and in the rabbit four seconds." (*Am. Journ. Med. Sci.*, N. S., xviii. 100.) The latter experimenter also found that the most rapidly fatal poisons, introduced into the veins of the animals referred to, gave rise to no signs of their action within less than the periods of time mentioned as occupied, in the several animals, by one round of the circulation. (*Ibid.*, p. 101.) Having introduced some hydrocyanic acid into the mouth of a rabbit, Dr. Blake noticed that its first effects on the system were evinced in two seconds and a half, and death followed in five seconds. (*Ibid.*, p. 106.) It is scarcely possible that any medicine can act more speedily than this; and, considering that the acid probably acted through the lungs, and, by entering the pulmonary veins, might reach the left side of the heart by a route much shorter than that of the general circulation, it is not too much to infer, that the time mentioned was sufficient for it to arrive at the brain through the medium of the blood. Vierordt, after experiments with a great number of animals of different species, came to the conclusion, that the mean duration of a round of the circulation in the several mammalia is equal to the average time in which the heart completes twenty-six or twenty-eight pulsations. (*B. & F. Medico-chir. Rev.*, July, 1859, p. 167.) It may be assumed that in man this time does not exceed thirty seconds. From these facts the inference may be fairly drawn, that no medicine acts with such rapidity as to preclude the possibility of its having reached the part affected through the circulation; and, the accuracy of the statements being admitted, the objection urged upon this ground against the universality of the mode of operation through the blood must be abandoned.

Medicines are absorbed from mucous membranes, the areolar tissue, the skin, the pulmonary air-cells, and probably from any other part of the body to which they may be applied. The rapidity of their absorption is proportionate to the thinness and delicacy of the tissue intervening between them and the blood-vessels. Hence, of all the surfaces with which they are habitually brought into contact, that of the pulmonary air-cells affords them the most speedy entrance into the circulation. Every one knows the great rapidity with which ether and chloroform act when inhaled. Next to the air-cells in this respect are probably the areolar tissue and the alimentary mucous membrane, especially that of the stomach, which, as a general rule, admits the entrance of medicines more readily than that of the rectum. Absorption takes place most slowly from the skin. This might be inferred from the firmness and thickness of the epidermis. It has indeed been maintained that this tissue is impermeable by medicines in its healthy state. But experiments have satisfactorily shown that they do enter the system through the epidermis; and the constitutional impression, sometimes resulting from the wearing of a mercurial plaster, is of itself a sufficient proof. There can be no doubt, however, that the epidermis opposes a great impediment to absorption; and, without such a protection, the system would be constantly exposed to the most deleterious influences from without. The impediment may be much diminished by softening the tissue with water, or by mechanically deranging it; and hence medicines applied to the surface by a local or general bath, or in the form of cataplasm, or by means of friction, may often be made to act efficiently on the system.* Deprived of its epidermis, the skin admits the entrance of medicines with great facility, though, even in this state, somewhat less readily than the gastric mucous membrane, probably because it is less vascular.

---

* At the time of the appearance of the second edition of this work, the result of recent experiments had not been favourable to the opinion, that medicines applied to the skin by means of baths, whether local or general, can, to any considerable extent, find an entrance into the system through absorption. For a condensed account of these experiments, the reader is referred to the *British and Foreign Medico-chirurgical Review for January*, 1859 (Am. ed., page 108). Numerous substances, mineral and vegetable, were employed in baths and foot-baths; and the uniform result, when care was taken to prevent any possible absorption through the lungs, was that neither the substances themselves, nor any of their constituents, could be found in the urine. The medicines thus experimented with were iodine, iodide of potassium, chloride of sodium, ferrocyanide of potassium, sulphuret of potassium, acetate of lead, alum, borax, carbonate of potassa, nitric acid and nitre, sulphate of magnesia, sulphate of quinia, digitalis, and belladonna. But I did not, at the time, consider the experiments as conclusive against the absorption, by means of baths, of many untried medicines, nor even, in some degree, of those tried; for, though not detected in the urine, some of them might have been eliminated by other

Means of Absorption. The lymphatics and lacteals were formerly supposed to be the exclusive agents of absorption. Magendie proved that foreign substances are also received from without directly into the blood-vessels; and multiplied experiments have since shown that most medicines enter the system in this way. It is probable that the capillaries, in consequence of the extreme delicacy of their walls, are chiefly concerned in the process; and that medicines enter them upon the same principles of endosmose by which liquids pass through dead membrane out of the body. Attempts have even been made to establish the conditions based on the rules of physical endosmose, upon which medicines in contact with the capillaries will either enter the blood-vessels, or cause the extravasation of the liquid contents of the vessels themselves, and thus to explain the effects of a medicine, if not indeed to deduce *à priori* its probable operation from its physical qualities. But, admitting to a certain extent this principle of operation in medicines, there are so many circumstances, physical, chemical, and vital, which modify the result, that no previous conclusions can be relied on; and even explanations upon this basis must be received with great caution, lest they lead into serious error. It must be remembered that the condition of a living membrane is very different from that of the same membrane out of the body; and there can be little doubt that the vital forces have such a control over the tissues, as greatly to modify their endosmotic relations to the fluids on opposite sides of them. For example, in a certain condition of vital influence the membrane may be contracted and firm, in another relaxed and loose; and it is impossible to say that some modifying power may not be exerted on the fluids themselves, in and around it, by the life-forces, as we know that the electric forces modify chemical conditions out of the body. In the present state of our knowledge, therefore, it is quite premature to attempt to explain the phenomena of medicinal absorption in every case, or to anticipate the results in any particular case, on simple physical principles.

---

circumstances, or have been retained in the system; and, if not absorbed in the instances submitted to trial, they might possibly be so in others. Certain substances have by former experiments been shown to be absorbed in this way; and it would require very numerous experiments with different individuals and under various circumstances, to determine positively that there is any soluble substance which can never enter the system, when applied by means of baths to the surface of the body in a perfectly sound state. Since that time, numerous experiments, performed with great care to avoid all sources of error, by Dr. Villemin, of [illegible], in France, have established beyond reasonable doubt the possibility of absorption by means of baths through the skin, not only of water, but of various medicinal substances. (Archives Générales, [illegible] 216, [illegible].) Nevertheless, it must be admitted, as stated in the text, that the epidermis opposes a very strong impediment to absorption; and that baths do not offer a very efficient method of medicating the system. *Note to the second and third editions.*

It is highly probable that the principle which governs the process of *dialysis*, discovered by Mr. Graham, may have some influence in the absorption of medicines. Crystallizable substances may thus find an entrance into the capillaries, while the uncrystallizable are excluded. For an explanation of this principle the reader is referred to the U. S. Dispensatory (12th ed., p. 896). The comparative facility with which saline substances and the active principles of vegetables, which are generally crystallizable, enter the circulation, may be in some measure thus explained.*

After the entrance of the medicine into the capillaries, it is carried forward in the course of the circulation, and sooner or later mingles with the blood in the heart, with which it is transmitted over the whole system, and consequently reaches the part on which it is destined to act.

But it may be asked whether medicines are not also taken up by the absorbents, and conveyed by them into the blood. It would seem to be the legitimate function of these vessels, to select from the alimentary liquid in the bowels, and from the disintegrating tissues throughout the body, those principles which may assimilate with the blood, and thus contribute to the sustenance of that fluid in its requisite state and quantity. In order that this function may not be interfered with, they have the power to reject in great measure noxious substances, and medicines among others. Tiedemann and Gmelin found that, of numerous colouring and odorous substances given to animals with their food, a large proportion imparted their colour and odour to the blood of the portal veins, but not one to the chyle. Of a number of salts tried in the same manner, though many could be detected in the veins, a few only had entered the thoracic duct. Drs. Lawrence and Coates, of Philadelphia, in a series of carefully conducted experiments, proved that ferrocyanide of potassium was taken up from the bowels both by the radicles of the vena portæ and by the lacteals. (*Philad. Journ. of Med. and Phys. Sci.*, v. 327.) It has been subsequently shown, in repeated instances, that poisons introduced into the alimentary canal, fail to produce their effects on the system when the vena portæ is tied. (Pereira, *Elem. of Mat. Med.*, 3d ed., i. 103.) From these statements it is fairly inferrible that, though the absorbents are capable of taking up a few saline substances, probably not altogether incongruous with the blood, they are not the ordinary agents by which medicines are introduced into the circulation.

Circumstances affecting Absorption. Various circumstances more or less affect the facility or rapidity of absorption. Reference has already been made to the influence, in this respect, of the nature of the surface to which the medicine is applied. The following are other modifying influences.

---

* Isomorphism in chemical compounds has probably some influence over the absorption as well as the assimilation and elimination of those substances; those which have a similar constitution in this respect, obeying the same physiological laws. This may be inferred from the experiments of M. Roussin on fowls, as recorded in the *Journal de Pharmacie*, 3e sér., xliii. 126. (*Note to the third edition.*)

1. In relation to the blood-vessels. It is highly probable that the varying condition of their coats, under varying nervous influence or different degrees of vital force, may considerably modify the process; but too little is precisely known on this subject to justify any definite statements.

2. The condition of the blood as to density may not be without effect upon the principles of endosmose, in favoring or opposing the entrance of fluids from without.

3. The fact has been abundantly proved, that fulness of the blood-vessels is opposed to absorption; and hence, in a plethoric state of the circulation, medicines sometimes act with difficulty, because not readily taken into the system. It is well known that, in a state of high febrile excitement, the abstraction of blood very much favours the action of diaphoretics and diuretics, probably in part, at least, by removing an impediment to their absorption. Substances, too, which act powerfully as local irritants, by causing congestion of the blood-vessels in the part, impede their own absorption, and thus fail to act on the system; while, if applied in a dilute state, so as not to irritate, they may find a ready entrance. Diminution of atmospheric pressure upon the surface impedes absorption, by causing distension of the vessels. Consequently cupping-glasses placed over a poisoned wound retard or diminish the action of poison on the system. Compression, on the contrary, is said to favour the process. Whenever the blood-vessels are relatively empty, absorption is promoted. Hence, medicines act more powerfully after fasting, and in reduced states of the system generally, than in the ordinary condition.*

4. Age and sex have some influence on absorption. M. Bouisson has found the process more active in the young than in the old, and in man than in woman. In the former case, the greater activity might be ascribed to greater rapidity of the circulation; but this explanation will not hold in the latter. (Archives Générales, 4e sér., [illegible])

5. Fodera has proved that galvanism or electricity promotes absorption.

---

* Some experiments recently made by [illegible] a harmony [illegible] [illegible] conclusion. [illegible] in starving animals the symptoms of poisoning [illegible] [illegible] [illegible] are [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] circulation of the blood [illegible] [illegible] [illegible] in the condition of the system. (Am. Journ. of Med. Sci., [illegible] [illegible]) The [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the action of [illegible] [illegible]. *Note to the second and third editions.*

6. The character and state of the medicine itself have also great effect. Allusion has been already made to the influence of density in opposing the absorption of medicines. Volatility appears in general to have an opposite effect; the most volatile medicines usually operating with greatest rapidity. Hence in part probably the very speedy effect of ether, chloroform, and hydrocyanic acid. Gases are readily absorbed.

7. Greater or less affinity between the medicine and the blood appears also to affect the facility of absorption; and substances which unite with that fluid with difficulty, are scarcely admitted into the system. Castor oil may be cited as an example.

8. The fluid form is usually considered essential to absorption, and consequently to medicinal activity, so far at least as the general system is concerned. It is true that many solid substances, nearly or quite insoluble in water, are powerful medicines. But they must undergo changes which bring them into the liquid state, before they can gain access into the blood-vessels. Such changes are often effected by the liquids of the alimentary canal. Thus, metals, in themselves insoluble and inert, often act energetically in consequence of oxidation and union with an acid in the stomach and bowels. But some recent experiments would seem to show that this principle is less universal than has been imagined. Rabbits were fed on finely powdered wood charcoal; and fine particles of this substance were afterwards found abundantly in the blood, the liver, and the lungs. Starch mixed with charcoal was given to frogs; and the corpuscles of the former were observed in the blood of the mesenteric veins, by the aid of the microscope, having their characteristic form, and exhibiting their characteristic reaction with iodine. Similar results, though less decisive, were obtained with mercury and sulphur, taken into the stomach, and applied by friction to the surface of dogs and rabbits.* It is conceivable that mercury, being liquid, though insoluble, should be able to penetrate the tissues; but it is impossible, with our present views of the capillaries, that solid visible particles should enter them without some solution of continuity in their coats. It is not improbable that such particles, passing mechanically between the epithelial or epidermic cells, and thus separated from the blood of the capillaries only by the extremely tenuous coats of these vessels, and the equally tenuous basement membrane, may, by their contact with this delicate tissue, cause minute openings in it, so as to admit their passage, by a sort of physiological action such as that which causes two cells in contact to communicate together; and these openings, after the entrance of the particles, may close under the influence of the same vital law.

---

* These experiments were made chiefly in Germany. Begun by Oesterlein, they were repeated and varied by Eberhard, Kölliker, Meyer, Donders, and Mensonides, all with more or less confirmatory results. (*London Med. Times and Gazette*, March 13, 1852, p. 270.)

9. Another modifying influence, exerted over the absorption of medicines, is probably their own power of altering the condition of the intervening membrane, either by a physiological or chemical action upon it. Thus, it may be readily conceived that the contraction produced by tannic acid, and the chemical reaction with solution of nitrate of silver, might interfere with the absorption of these medicines in an unchanged state.

Changes in Medicines before and after Absorption, and their Elimination. Of the organic medicinal substances none are probably taken into the system in the exact state in which they are furnished by nature. It is only certain proximate principles contained in them that are absorbed, such as the volatile oils, vegetable alkaloids, bitter and colouring principles, etc.; the residue being left behind when they are applied externally, and either digested, or thrown off by the bowels, when they are swallowed. Thus, in the instance of garlic, the gum, starch, sugar, and albumen are probably digested, the lignin passes off with the feces, and the volatile oil alone is absorbed. In like manner, Peruvian bark probably yields its quinia, cinchonia, and other alkaloids, rhubarb its colouring matter, and aloes its bitter purgative principle to the blood; while the remaining constituents are evacuated or destroyed.

A great number of medicines undergo various changes in the stomach and bowels before absorption, in consequence of the chemical reaction between them and the acids, salts, and various animal principles, introduced or secreted, which abound in these passages. Alkalies, alkaline earths, and many metallic oxides are neutralized by acids; metals are oxidized and form salts; metallic salts form combinations with albumen or other proximate organic principles, or undergo decomposition with sulphuretted hydrogen or other acids, or by reaction with other saline compounds; carbonates are decomposed, with the extrication of carbonic acid in the stomach and bowels; salts with vegetable acids yield their acid constituent to the digestive process, while their bases appear to enter the circulation as carbonates; acids often combine with bases and form salts; iodine and chlorine become acidified and then neutralized; and, by some one of the above, or by other chemical reactions, insoluble substances are rendered soluble, and consequently more capable of absorption.

Some medicines appear to be absorbed unchanged, as ether, alcohol, chloroform, hydrocyanic acid, various proximate organic principles previously isolated, as the volatile oils and vegetable alkaloids, and many saline bodies in aqueous solution.

It should be observed that medicines are not confined to the bloodvessels in their course through the system. By the principle of diffusion, many of them escape from the capillaries into the neighbouring tissues; and they may thus penetrate into the interior of structures containing no blood-vessels, cartilages for example. Dr. H. Bence Jones detected traces of lithia in the superficial parts of the crystalline lens, thirty minutes after the swallowing of chloride of lithium; and in two hours and a half it was found throughout the lens.*

After entering the circulation, many medicines undergo chemical change, through the agency either of principles they meet with in the blood, or of the constituents of the various tissues with which they come in contact. The character of these changes is not well understood, and for the most part is merely conjectural. It is possible that some soluble substances may become insoluble, and by a mechanical operation modify the state of the capillaries. It would seem that certain metallic compounds are reduced; as mercury and silver are asserted to have been found in the metallic state in the tissues. Some medicinal substances, as alcohol, probably serve in part the purpose of nutrition or respiration; being, in the latter case, oxidized and thrown off from the lungs, in the forms of water and carbonic acid.

Sooner or later almost all the substances absorbed are eliminated from the system, either unchanged, or variously decomposed; the change being produced either in the circulation, or in the process of elimination. Examples of such change we have in the oil of turpentine, which imparts not its own, but a violaceous odour to the urine, and in benzoic acid, which, when taken into the stomach, is eliminated by the kidneys in the form of hippuric acid. The elimination is usually effected, for solid or non-volatile matters, by the great secreting organs, especially the kidneys and the skin; and so frequently are the former emunctories the avenue of escape, that, when evidence is required of the absorption of any medicine, it is almost always sought for in the urine. Volatile substances escape not only by these organs, but in general abundantly also by the lungs.

The period required for elimination is very various with different substances. With some the process begins almost immediately, and is completed in a short time; with others, it is in various degrees protracted; and, with a few, many months elapse before the system is entirely freed from them. Thus, A. F. Orfila, having administered bichloride of mercury, sulphate of copper, acetate of lead, and nitrate of silver to dogs, for a sufficient length of time to impregnate their systems with those metallic poisons, found, upon killing the dogs, and submitting their bodies to a rigid chemical examination, that mercury disappeared from their system in a period of from eight to eighteen days, silver sometimes as early as six weeks, but in other instances not until the expiration of six months; while lead and copper were found in the liver eight months after they had ceased to be administered. (*Gazette des Hôpitaux*, Jan. 24, 1852.) With perhaps the single exception of silver, it has not been demonstrated that any substance given medicinally remains permanently in the system; and in reference to this, only in a few rare instances, in which it has been given in large quantities, and for a long time. Under such circumstances, it sometimes leaves a permanent dark stain of the skin, probably from the deposition of its oxide in the substance of the true skin.

---

* Dr. Jones experimented upon patients operated upon for the extraction of cataract, giving the salt of lithium at various times before the operation, and examining the cataract afterwards by spectrum-analysis. Upon exhibiting the carbonate of lithia, he found lithium in every particle of the cataract in 3·5 hours, traces still remaining in 4 days, and its entire disappearance in 7 days. (*Med. T. and Gaz.*, Sept. 1865, p. 246.)—*Note to the third edition.*

SUBSECTION II.

Primary Operation through the Nerves.

About half a century ago, it was a prevalent belief that medicines operated on parts distant from the seat of their application by means of sympathy; in other words, by the transmission of their local impression through afferent nerves to the nervous centres in the encephalon, spinal marrow, or ganglia, and its radiation thence to the part or parts affected. In favour of this opinion, was, *in the first place*, the want of proof, in relation to the great majority of medicines, that they ever penetrated into the system beyond the original surface of contact; and, *secondly*, the great rapidity with which some of them produced their effects, which was supposed entirely to preclude the possibility of their actual conveyance to the seat of those effects. But, since it has been discovered that almost all medicines are capable of being absorbed into the circulation, and that perhaps in no instance are their effects felt in a time shorter than that required for their conveyance with the blood to the part acted on, the explanation of their operation by sympathy, or through the medium of the nerves, has become unnecessary, and in reference to most medicines is, I think, quite untenable.

It is true that many medicines produce local impressions, which are followed by effects in parts more or less distant, that cannot be explained upon the supposition of the transfer of the medicines themselves, and must, therefore, be brought about through nervous agency. Thus, veratria and ammonia, applied to the mucous membrane of the nostrils, occasion sneezing undoubtedly through the intervention of the nerves and the nervous centres; and in the same way we must account for such effects as the sweat and feeling of coolness in the forehead, sometimes following the application of common salt to the tongue, and the flow of tears and saliva resulting from horseradish in the mouth. But it will be observed that these are secondary effects, dependent on mere irritation of the part first impressed, and which might equally result from any other cause capable of producing an equal amount of irritation. They are not the primary or characteristic action of the medicines, which alone we are now considering. To fulfil the conditions of the theory of nervous transmission, it is necessary that the first impression on the surface of application should be conveyed unchanged, or merely modified; or at least that the remote effect should be of a characteristic nature, and not the same as that which any irritant might produce.

Yet it cannot be denied that there are facts tending to show that, in some instances, medicines do propagate their primary and peculiar influence through the nerves. Thus, certain fetid substances, which act efficiently as antispasmodics when introduced into the stomach or rectum, seem, by their mere impression on the olfactory nerves, to give rise to the same effects; and tobacco and lobelia occasion, by their presence in the fauces, nauseating impressions very similar to those produced by them when swallowed. I think every practitioner in the habit of administering opiates by enema, for the relief of nephritic and uterine pains, strangury, etc., must have witnessed a greater and more speedy effect from them thus given, than when taken into the stomach. This can be accounted for only by the transmission of their anodyne influence through the nervous centres; as, if absorbed into the circulation, they would reach the seat of action no sooner than if absorbed from the stomach, and, indeed, less speedily and efficiently; as medicines administered by the rectum are well known to affect the system less readily than when swallowed. It is, therefore, I think, premature to reject altogether this mode of medicinal operation; and, indeed, it is not impossible that some substances may operate in both ways, giving rise to an impression through nervous transmission, which may be afterwards strengthened, and perhaps modified, by the immediate action of the medicine through the circulation.

SUBSECTION III.

Primary Local Operation.

By the expression, *local action*, is here meant that exerted on the part, or in the immediate neighbourhood of the part, to which the medicine is originally applied.

Some medicines are exclusively local in their operation. Such are those applied directly to any surface, with a view to some mechanical, physical, or chemical influence on that surface. It is probable that certain medicines which act physiologically, that is, through the vital properties of the system, are also exclusively local. Medicines incapable of being absorbed, if there be any, would belong to this category. An example of this kind, I am inclined to think, we have in castor oil.

Many medicines are, under certain circumstances, local in their action, which, under others, may enter the system, and operate on distant parts. Thus, substances capable of violently irritating or inflaming the surface to which they may be applied, when employed so as to produce this effect, are little apt to be absorbed, in consequence probably of the distension of the capillaries; whereas, if previously diluted so as not to irritate, they may find a ready entrance into the circulation.

Other medicines both act locally, and, entering the circulation, produce the same or dissimilar effects on distant parts. Thus, opium and chloroform operate as anodynes on the nerves of the part to which they are applied, and subsequently produce the same effect throughout the system by acting upon the nervous centres; while tartar emetic is irritant in its local operation, but sedative when acting through the circulation upon the heart. Medicines of this kind are often used in reference to their local effects.

In most cases of local action, the influence of the medicine extends more or less beyond the original surface of contact. Thus, the anodyne influence of chloroform, applied to the skin, often penetrates through this tissue to parts beneath it, and the same may be said of opium, camphor, aconite, and other medicines of the kind. Castor oil, applied to the inner surface of the alimentary mucous membrane, calls the muscular coat into action. An irritant substance often extends its effects both deeply into the tissues, and to a considerable distance superficially beyond the surface of contact. How is this result to be accounted for? In some instances, probably, by the penetration of the neighbouring tissues, to a certain extent, either on the principle of the diffusion of liquids, or on that of capillary attraction, or of both. In others, the effect may be propagated by what Mr. Hunter denominates continuous sympathy; spreading along the course of the tissue affected, with a gradual diminution, until quite lost. Again, it is not impossible that the influence may be extended to neighbouring parts through common nervous centres; as when the extract of belladonna, rubbed upon the eyelids, produces dilatation of the pupil, or opium in the rectum relieves pain in the ureters; in neither of which instances can the result be fairly ascribed to the circulation, as the effect should in this case be, what it is known not to be, equally great and rapid to whatever part of the body the medicine may be applied, supposing it to be equally distant from the heart, and to afford equal facilities for absorption. Finally, the effect may be secondary, as in the instance of castor oil, which directly irritates the mucous membrane, and, as any other similar irritant would do, indirectly excites the peristaltic movement, through the agency of the physiological law which determines the latter result as a necessary consequence of the former.

SUBSECTION IV.

Modes of Primary Operation.

Hitherto we have been considering rather the seat of the operation of medicines, and their manner of reaching it, than the mode in which they produce their effects. The latter point must now receive attention.

1. *Mechanical or Physical Methods.* The operation of medicines may, in some instances, be purely mechanical or physical. Thus, they may act by excluding the atmospheric air, as in the instance of collodion applied to the skin in cutaneous affections; by mingling with and obtunding the acrimony of various acrid substances, as in the operation of demulcents; by the influence of gravity, as illustrated by the laxative effects of metallic mercury; or by their shape and bulk, as when bran, mustard seed, small shot, etc., operate on the bowels by a mechanical irritation of the mucous membrane.

Endosmose and Exosmose. Another physical mode of action has been suggested, which, though not satisfactorily established, is not without a certain amount of plausibility. Reference has already been made to the entrance of medicines into the blood-vessels on the principle of endosmose. Poiseuille and others have demonstrated that, if the serum of the blood be placed on one side of an animal membrane out of the body, and certain strong saline solutions, or other concentrated liquids on the other side, a current of the serum is made to set through the membrane towards the denser liquid; while, if the solution be very weak, the current is established in a contrary direction. Hence, it has been suggested that strong solutions of certain salts in the stomach and bowels may act as cathartics, by producing an extravasation of the serum from the blood-vessels; while weak solutions of the same may enter the vessels, and thus act on the system generally. This principle has been extensively applied to the explanation of the action of medicines; the general rule being, that a liquid denser than the blood will produce exosmose of the serum, and thus operate as an evacuant.* But the principle is not reconcilable with many facts which might be adduced, and is wholly insufficient to explain many others. To mention only a single example; chloroform taken internally, or applied to the surface of the body, produces effects on the system which can scarcely be referred to any other cause than its presence in the circulation. It must, therefore, enter the blood-vessels, though vastly denser than the serum of the blood, and fails to produce the extravasation, which ought to take place upon the principle of exosmose referred to. Still, this physical property may be received as one of the probable agencies through which medicines operate, though, in the present state of our knowledge, it cannot be admitted as of universal or even general application.

---

* See experiments of Poiseuille (*Comptes Rendus*, xix. 944, A.D. 1844), and of Dr. Cogswell (*Lond. Med. Times and Gaz.*, Jan. 3, 1852, p. 23). See also an essay by Prof. Jos. Carson, on osmosis in its relation to medicine, in the *Am. Journ. of Med. Sci.*, July, 1865, p. 135.

The supposed agency of endosmose and exosmose has been carried much further than to the explanation of the action of medicines on exposed surfaces. Thus it may be exerted in the circulation itself, causing the character of the red corpuscles to vary with the varying relative density of the serum without, and the liquid within the corpuscles; so that whatever increases the specific gravity of the serum, as certain salts, for example, shall cause an exosmose of the corpuscular contents, and a shrinking of those bodies, and whatever diminishes its density, as water, shall occasion an endosmose into them, and their consequent distension or rupture.

Still further, it is thought that the relative density of the liquor sanguinis in the capillaries, and of the moisture without them, may be one of the controlling influences in the operation of medicines which act through the circulation. If the nature of the medicine be such as to increase the density of the blood, it would tend to promote absorption from the tissues, if to lessen it, to favour extravasation into them; and the same explanation ought to apply also to the influence of medicines within the circulation upon the various secretions. At present, however, all this is merely hypothesis or conjecture; and must be placed upon the same basis of admissibility with that theory of the operation of medicines, which ascribes it to the mechanical influence of the shape of their ultimate particles upon the tissues with which they come into contact.

2. *Chemical Methods.* Reference is not had, in this place, to the chemical changes which medicines undergo in the alimentary canal preparatory to absorption, nor even to those which may take place in the course of the circulation or elimination of the medicines, so far as relates exclusively to the medicines themselves. But, when these chemical changes of the medicine in the circulation result from reactions between them and the constituents of the blood or the tissues, it cannot but happen that physiological alterations must take place, which may possibly be more or less remedial; and the consideration of such changes belongs strictly to this section.

Some medicines have so strong an affinity for the constituents of the tissues, that, when in contact with them in a concentrated state, they overcome their vital resistance, and cause the decomposition and consequently the death of the part. In this way many caustic substances act. In a dilute state, this affinity is more than counterbalanced by the vital forces, and no chemical change ensues. As medicines never extend, in this state of concentration, far beyond their original surface of contact, it is obvious that similar decomposition of the tissues cannot result from their operation on the system, either by the circulation, or through the medium of the nerves.

It is highly probable, however, that many medicines produce chemical changes in the blood, which enter into their remedial action. The blood consists of certain vitalized, and certain unvitalized constituents, the latter of which are probably merely held in solution, and are subject to the same chemical reactions as if dissolved in a fluid out of the body. Thus, an acid medicine, absorbed into the blood, may prove remedial by neutralizing a morbid excess of alkalinity; and, conversely, an alkaline medicine, by correcting any morbid acidity of that fluid. It is highly probable that many analogous changes may take place; and to some of these there will hereafter be occasion to allude in the account of particular medicines, or classes of medicines. It is even possible that the normal condition of the blood may be so far modified by such a chemical agency, exerted for example upon its albumen, its fibrin, its salts, etc., as to alter materially the influence of that fluid upon the tissues and functions, and thus to give rise to systemic actions or conditions, which, though in fact only the secondary effects of the medicine, are usually regarded as the results of its direct and characteristic operation. But these changes can be traced only conjecturally; and there are very few, if any, which can be truly said to have been experimentally demonstrated.

Another mode in which a medicine may act chemically, after absorption, is at the time of elimination by the secretory functions; when, coming in contact with the products of secretion, it, or one of its constituents, or some compound which may have been formed by chemical reactions with it in the course of the circulation, may materially modify these products. Thus, alkaline medicines, eliminated by the kidneys, render soluble the uric acid, or insoluble urates, which may have been deposited from the urine after its secretion.

It is not impossible that the peculiar effects of medicines on the system, may sometimes result from chemical reaction between the medicines and the tissues with which they are brought into contact while in the blood, or into which they may have been diffused from the capillaries. Reactions between the constituents of the tissues may take place through the agency of the medicine, acting either as a ferment, or by what has been called disposing affinity, as when the presence of an alkali disposes to oxidation, so as to form an acid with which it may unite. Combinations may be formed between the medicine, or one of its constituents, and some one or more of the constituents of the tissues, at the moment of their physiological disintegration; and these compounds, retained in the organs, perhaps within the organic cells, perhaps in the interstices of the tissue, may modify the functions in a manner that may prove remedial. These results, I repeat, are possible; and the theory has been advocated that medicines generally act by affecting the normal oxidation of the tissues; some favouring oxidation, and thus producing one set of effects, others retarding or suspending it, and thus causing opposite results; but it has not been proved positively that medicines do really produce their peculiar effects in this way in any one instance; and it is altogether premature to explain the whole agency of medicines upon the grounds of their chemical influence. The only well-ascertained fact which can be adduced in support of the hypothesis is, that certain medicines, particularly the metallic, may be detected in the substance of the organs, often for a considerable time after they have been taken.

3. *Physiological, Vital, or Dynamic Methods.* Most medicines probably produce their peculiar effects by operating on the vital properties of the system, or of the part affected. Of the nature of this action we are quite ignorant, and must remain so until the nature of life itself is better understood. In the present state of our knowledge, all that we can say is, that living structure is endowed with certain susceptibilities, and medicines with certain properties, or powers, through which, when the two are brought together, certain changes of condition or action take place in the former. The medicine is said to act, and the living structure to be acted on, because it is in the latter that the changes are most obvious, and most interesting. This kind of operation is called physiological, or vital, in reference to the character of the effects produced in the system, and dynamic, in reference to the supposed possession of an active power by the medicine. We may speculatively ascribe the results to physical or chemical reaction; but this explanation is, in the great majority of instances, destitute of the shadow of proof, and is indeed altogether insufficient, with our existing knowledge of physics and chemistry, to account for many of the phenomena. Until, therefore, further light is obtained, it is safest to be content with the mere statement of the fact.*

When medicines are introduced into the system, they generally show a tendency to act on some one part, or set of parts, preferably to others, and not unfrequently act on these parts exclusively. Thus, some medicines operate more especially on the brain, others on the heart, others on the stomach and bowels, and others again on some one or more of the secretory organs, though equally in contact with the parts unaffected as with those upon which they act. This tendency is ascribable to the peculiar constitution of the several parts of the system, giving them peculiar susceptibilities; just as the eye alone is sensible to light, and the organs of smell and taste to odours and sapid substances. A medicine, therefore, entering the circulation, and reaching all parts of the system, acts on such parts only as are so constituted as to be susceptible to its influence; as light, though falling on the whole surface of the body, produces its characteristic impression only upon the eye. The chemists explain this peculiar direction of medicines by the supposition, that it is only in the organs affected that they find affinities capable of being disturbed by their presence.

---

* Much has been said of late of another mode of action of medicines, based on their influence upon the function of nutrition; some being supposed to act by increasing that function, others by diminishing it. Of course, medicines which stimulate or depress the functions generally must stimulate or depress nutrition, as they affect other functions; and there may be some whose special tendency is to act upon nutrition; but the resulting changes are effects of the medicines and not their method of action. The question arises, how do they increase or diminish nutrition? and we are then brought back to the chemical or physiological theory. (*Note to the third edition.*)

It is not impossible that some medicines may act upon the blood through its vital properties, modifying the condition of the living corpuscles and fibrin, in the same manner as others act upon the living solid tissues. Such medicines may operate exclusively on the blood, producing effects upon the various functions simply through the change effected in that fluid; or they may operate at the same time directly upon the organs. The probability, however, is, that, in the great majority of instances, medicines are merely conveyed by the blood to the part in which their effects are experienced; for otherwise these effects would be more frequently universal, as any change in the blood itself must be felt more or less in all the organs and functions.

SECTION II.

Secondary Operation of Medicines.

The secondary operation of medicines has been already defined to be that which follows their original and characteristic impression, in consequence of certain physiological laws. Without treating in this place of the resulting effects, it will be proper to explain, in a general way, the several modes in which they are produced.

1. *By the Depression following Excitement.* It is a general physiological law, that excessive exitement of any function must be followed by a corresponding degree of depression, upon the removal of the cause. When, therefore, an excitant medicine ceases to act, its original and characteristic operation is succeeded not only by a subsidence of the excitement, but by a reduction of the actions of the part affected below the standard of health. This depression is often experienced even before the complete elimination of the medicine from the system; for the excitability may have been so far exhausted by the excess, that the influence of the excitant ceases to be felt, and the healthy vital stimuli have no longer their ordinary influence. The prostration which fol-

lows a debauch is often observable, while yet the breath smells of the alcohol.*

2. *By the Reaction following Depression.* When any of the functions are depressed by an agency which simply restrains action, without impairing the vital forces or deranging the organization, there is a tendency, upon the cessation of the depressing influence, to an elevation of the function beyond its medium state. This depends upon the principle, that excitability is recruited by rest. The resulting elevation of function is usually denominated reaction. It is, however, much less frequently noticed as a consequence of depressing medicines, than the contrary condition of depression after excitants; probably because sedative medicines usually impair power, as well as reduce action. A fine example of it is afforded in the reaction which follows the depressing influence of cold.

3. *Through the Dependence of Function.* Most of the functions of our system are more or less mutually dependent, so that any considerable derangement of one will in some degree affect the others. A disturbance, therefore, of one of the more influential functions, produced by a medicine acting primarily upon the organs of that function, will be followed by disorder in all the rest; and this disorder will obviously be a secondary effect of the medicine. Thus, alcohol, opium, and quinia, largely taken, occasion so much excitement and active congestion of the nervous centres in the brain, as to disqualify them from transmitting their usual influence to the various organic functions, as those of respiration, circulation, and secretion, which consequently become much depressed; and general prostration ensues. The active cerebral congestion is a primary, the general prostration a secondary effect of the medicine. This is a highly important principle, and of very extensive application. A due attention to it is essential to the practitioner. Suppose that it should be disregarded in the cases just stated, and the prostration considered as the result of the direct and characteristic action of the medicine. A powerful stimulant to the brain might thus be mistaken for a really sedative medicine, and administered with the most serious results in cases of cerebral disease.

In like manner, a medicine, powerfully depressing in its action upon the cerebral centres, would be followed by great general prostration; and this would really be, as well as in the former instance, a secondary effect: but there is not the same necessity for making the distinction;

---

* This law of depression following excitement is denied by some late writers; and there may be one or two apparent exceptions to the universality of the law, as in the instance of nitrous oxide; but of its general truth I can have no doubt. The point is one not of theory but observation; and every one must be determined by his own experience. Mine has been most assuredly in favour of the existence of such a law. (*Note to the third edition.*)

because the secondary is of the same character with the primary effect, and no mistake could occur of the nature of that above referred to.

The results of what is denominated *the shock*, are another example of the secondary operation of medicines belonging to the same category. Any sudden and violent impression, as from a fall, a blow, a surgical operation, or some strong emotion, primarily overwhelms and paralyzes the cerebral centres, and secondarily occasions general prostration. Now certain medicines of great violence, as for example the corrosive poisons taken largely into the stomach, may produce a similar shock upon the nervous centres, followed by a similar general depression, which, without a knowledge of this principle, might be mistaken for the result of a directly depressing agency, and treated as such with very serious consequences.

The operation upon the system at large of medicines which act by changing the character of the blood, is another example of the same kind. The general effects result from the state of the blood, and not from the immediate influence of the medicine, and are, therefore, secondary effects of the latter.

4. *Through the Principle of Sympathy, or Nervous Transmission.* Though it is not probable that special or peculiar impressions of medicines are, to any considerable extent, conveyed from the part impressed through the nerves to the nervous centres, and thence transmitted to other parts, yet mere excitative impressions, or those consisting in pure irritation or inflammation, are undoubtedly thus conveyed. What is special in the influence of the medicine is, therefore, mainly limited to its surface of contact; while it is only the pure irritation, such as may result from any irritating cause whatever, that is conveyed away, and propagated through the nerves. This transmission of irritation arises from a general physiological law, and is, therefore, a secondary effect of the medicine. Thus, a rubefacient or epispastic may excite so much local inflammation as, through the nervous centres, to bring many of the organs into sympathy, and in this way to produce general excitement, and even fever. The increased frequency of pulse, heat of skin, cerebral disturbance, etc., which enter into this excitement, are secondary effects of the rubefacient or epispastic, the primary action of which is limited to the portion of skin to which it was applied. This principle is also of extensive application in explaining the effects of medicines.

5. *Through the Principle of Revulsion or Derivation.* There is in the system but a limited amount of blood, and of nervous power. When these are concentrated, or accumulated in undue amount, by the influence of a local irritant or otherwise, in some one part or organ, they must be deficient elsewhere; and a depression must ensue in those functions which are not irritated by sympathy with the part or organ originally affected. Supposing the local accumulation of blood and nervous power

to be the result of the action of a medicinal agent, the depression produced elsewhere is a secondary effect of that agent. Now it may have happened that the parts depressed were previously in a state of morbid excitement, which has thus been diminished and perhaps entirely removed by the direction given towards the seat of the primary influence. The name of *revulsion* or *derivation* has been given to this forced transfer of morbid action; and we frequently avail ourselves of the principle in the treatment of disease. It is upon this principle that a blister relieves internal inflammation. It is upon this, also, in part, that a cathartic, by producing a moderate irritation along the whole course of the intestine, draws off morbid excitement from other organs, and especially from the brain. Indeed, whatever remedy occasions a local irritation may thus prove the means of relieving irritation elsewhere. It is quite obvious that the diversion of disease thus effected is a secondary operation of the remedy.

Upon the same principle exactly, operating reversely, a depression of any part or organ, by diminishing the blood and nervous power in the part affected, must cause their accumulation elsewhere; and thus depressing or sedative medicines, acting locally, may, through a secondary operation, cause irritation in some other position. For example, cold water applied to a gouty foot, by diminishing the inflammatory excitement there, may secondarily occasion inflammation of the stomach. Medicines are not often employed in reference to such effects; but this mode of secondary action should be understood, if on no other account, at least in order that its injurious effects may be guarded against.

6. *Through the Efforts of Nature to Repair Injuries.* It may be considered as a general law of the animal economy, that when any injurious influence is exerted upon the system, actions are induced with the object, and frequently with the effect, of obviating the injury, or repairing the damage inflicted. It is probable that many diseases are nothing more than the struggles of the system to free itself from some noxious agent, or to counteract its influence. The abnormal impressions made by medicines are often, in obedience to this principle, followed by resisting or corrective efforts of nature, which must rank among the secondary effects of the medicine, and may sometimes be taken advantage of for remedial purposes. Thus, the death of a part produced by an escharotic is the primary effect of the medicine; the subsequent inflammation, ulceration, sloughing, and suppurative discharge are secondary effects, intended for the repair of the injury, and useful in reference to pre-existing disease upon the principles of revulsion and depletion.

7. *Through the Removal of the Cause.* Very many of the morbid actions or states of the system are secondary, depending upon the existence of some other action or condition, upon the removal of which the effect also ceases. It is obvious that a medicine which by its primary

operation removes the cause, and thus cures the disease, acts secondarily in relation to the latter effect. Thus, acid in the stomach often occasions severe headache, which is cured by an antacid, or an emetic. The neutralization or evacuation of the offending agent is the primary operation of the medicine, the cessation of the headache a secondary effect. This is a very extensive remedial principle.

It is very often difficult to determine which are primary and which secondary effects of medicines; and the decision of the question will often rest on the view which may be entertained of the mode of action of the remedy. In the instance, for example, of a sedative depressing the cerebral functions, the question of its primary or secondary action on the brain will be determined by our opinion upon the point, whether it is merely carried by the blood to the brain, or operates on that organ exclusively through changes first produced in the blood, incapacitating that fluid for the performance of its proper functions. In the latter case, the characteristic sedative operation of the medicine must be considered as secondary. But it is the safest rule to consider the obvious effects of a remedy as primary, unless some intermediate stage in its operation can be positively demonstrated, or rendered extremely probable by observed facts.

CHAPTER II.

Effects of Medicines.

SECTION I.

Estimation of their Powers or Effects.

In treating of the effects of medicines, the first point which offers itself for consideration is the method by which they can be ascertained. Is it possible to determine, before trying a medicine upon the human system, what will be its effects? Do its sensible or chemical properties, its botanical relations, or its action upon inferior animals, afford us any facilities in this respect?

1. *Through their Sensible Properties.* Much importance has been attached by some to the sensible properties of colour, taste, and smell. In relation to the first, it is probably altogether useless. The times are long past, when a correspondence between the colour of a medicine, and that of the fluids or solids of the body, was considered as indicative of a therapeutic relation; when, for example, dragon's blood was thought useful in hemorrhage because it was red, and turmeric in jaundice because it was yellow. The smell and taste, however, are more significative; substances resembling each other in these respects, having in many instances a similarity of medicinal effect. Thus, aromatics are usually excitant, carminative, and anti-emetic; fetid substances, often antispasmodic; sweet substances, demulcent; those having an astringent taste, styptic; and bitters, tonic: but, in such general statements, allowance must be made for so many exceptions as to deprive them, in a great measure, of practical value.

2. *Through their Chemical Relations.* Analogy in chemical constitution is also not unfrequently attended with similarity in medical virtues. The preparations of any one of the ordinary metals have a remarkable correspondence in their effects upon the system; and there are several metals which greatly resemble one another. The mineral acids, the vegetable acids, the inorganic alkalies, and the neutral salts of the alkalies, constitute groups, of which one individual may often be substituted for another without disadvantage. But in this respect, as well as in relation to sensible properties, there is so much uncertainty,

that no practical conclusion in reference to the properties of any particular medicine should be relied on without careful trial.

3. *Through their Botanical Affinities.* The same may be said of botanical affinities; though more importance has perhaps been attached to these than to either of the preceding grounds of judgment. It might indeed be inferred, that the similarity in internal constitution, which gives to plants those resemblances in obvious structure which serve as the basis of their arrangement into natural families, would also give them a certain identity in other respects, and among the rest, in their operation upon the system; and observation has, to a considerable extent, confirmed the truth of the inference Plants belonging to the same genus yield very frequently not only similar, but identical medical products. Thus, the oaks yield tannic acid, the pines oil of turpentine, the cinchonas quinia and cinchonia, the different species of strychnos strychnia and brucia, the gentians gentianin, the poppies morphia, and the garlics a characteristic volatile oil. This resemblance extends also very frequently to much larger groups; and many of the natural orders of plants have great similarity in medical virtue. Examples of this we have in the *Malvaceæ*, which are demulcent, the *Gentianaceæ* tonic, the *Convolvulaceæ* purgative, the *Solanaceæ* narcotic, the *Euphorbiaceæ* emeto-cathartic and acrid, the *Pinaceæ* stimulant, the *Brassicaceæ* stimulant, pungent, and acrid. Yet in almost every family there are instances, and, in some, very striking instances, in which not only are the characteristic medical properties wanting, but others wholly different, and even in some measure opposite are possessed; while similar and even identical medical virtues belong to plants having no botanical affinity whatever. Thus, in the *Convolvulaceæ* above mentioned, there are some species wholly destitute of purgative properties, as the esculent sweet potato; and among the *Solanaceæ* is capsicum, which is simply stimulant, without being in the least narcotic. Among the *Ranunculaceæ* is *Hepatica*, which is slightly astringent, tonic, and demulcent; *Helleborus*, powerfully purgative; *Zanthorrhiza* and *Coptis*, simply tonic; *Aconitum*, acrid, sedative, and narcotic; and *Cimicifuga*, chiefly nervine. Of medicines having analogous properties, yet derived from different families, we have examples in the volatile oil of *Pimpinella anisum*, belonging to the *Umbelliferæ*, and that of *Illicium anisatum*, belonging to the *Anonaceæ;* in the oil of turpentine proceeding from the *Pinaceæ*, and from *Pistacea Terebinthus* of the *Anacardiaceæ;* in the aromatic products of the *Umbelliferæ*, *Myristicaceæ*, *Myrtaceæ*, and *Zingiberaceæ;* in the astringent roots and juices of plants belonging to the *Fabaceæ*, *Polygonaceæ*, *Cinchonaceæ*, *Geraniaceæ*, and many other families; and in the simple bitter tonics obtained from the *Gentianaceæ*, *Simarubaceæ*, *Ranunculaceæ*, and *Menispermaceæ.*

But in reference to each of the analogies above alluded to, the sensible, the chemical, and the botanical, though none should be relied on in estimating the virtues of a medicine, yet each may be frequently suggestive, and, in relation to any new subject of inquiry, may be valuable by giving a proper direction to experimental investigation.

4. *By Experiment or Observation on Inferior Animals.* The effects produced on the inferior animals are more to be relied on, and will generally be a safe guide to the employment of medicine in man; but even this rule is not without exceptions. It is well known, for example, that sheep, goats, and cows eat with impunity the leaves of Hyoscyamus niger, which are highly narcotic, and in large quantities poisonous to the human subject.

5. *By Observation of their Effects on Man.* The only certain means, therefore, of judging of the effects of medicines, is to observe carefully their operation in man; and, even in this mode, multiplied observation under diversified circumstances, and a most cautious comparison of results, are necessary in order to arrive at the truth. From the want of these precautions, many errors in relation to the action of medicines have originated, and been handed down from writer to writer for many years; and, even at the present time, there are medicines which have been long in use, upon the precise virtues of which opinion is yet unsettled.

SECTION II.

Whether the Effects are Organic or Functional.

The effects of medicines, in other words, the changes produced by them in the system, must be either organic or functional; that is, must consist in an alteration, either of the organization or structure, or of the function or actions of the body, or of some one or more of its parts. Some have denied that there can be any change of action, or any action whatever, in the system, without change of structure, and consequently that the effects of medicines can ever be exclusively functional. This denial is founded upon the assumption that, in every operation of a living system, there is necessarily a chemical action, an oxidation perhaps of some portion, however minute, of the part or tissue acting, by which it becomes disintegrated and thrown off; while its place, in the healthy state, is supplied with new structure. This may be true, but it has not been proved; and, in the mean time, cannot be received as the basis of a general theory of the action of medicines. But, even admitting its truth, it does not follow that in all cases of physiological action there must be an alteration of structure. Suppose an organ to be secreting. The general opinion now is that the function is performed by the agency of cells, which, abstracting the material of the secretion from the blood, elaborate it when elaboration is necessary, and then, breaking up themselves, are thrown off with the secreted matter; their place being supplied by new cells. There has not been necessarily in this case any change of structure. One or more cells have disappeared, and their place has been supplied by one or more new cells of the same character exactly. The organ is precisely as before. There has been change of matter, but no change of structure or organization.

Now it may be readily conceived that a medicine, affecting the secretory function of an organ, shall act simply by increasing or diminishing the rapidity of the cell-action; that, in the time required in health for the throwing off and replacing of a certain number of cells, twice the number may undergo the same process in the one case, or only half the number in the other; and yet the organ shall remain precisely as in health, and in no degree altered; the only appreciable difference, even in its condition, being the greater or less amount of blood contained within it, or passing through it in a given time, and the greater or less amount of the secreted product. Medicines may, therefore, change the action of an organ, as regards the degree of rapidity, without altering its structure; and the same may be said of the nature of the action, as indicated, for example, by the character of the secretion; for a cell may elaborate different secretory products, according to the quality of the blood, or of the foreign materials brought with it, without differing in the least in its characteristic form or structure from the normal cell.

But, throwing aside this refinement of discussion, we may assume as functional effects all that are not attended with appreciable structural change; and as organic, all that are attended with such change; and this is the meaning which I attach to these terms, as employed in the present work.

In the sense just referred to, the effects of the great majority of medicines, as ordinarily used, are exclusively functional; and it is chiefly those employed externally, to inflame, vesicate, or cauterize, that can be said to operate essentially by a change of structure.

SECTION III.

Characteristic Effects of Medicines.

Medicines either increase, lessen, or alter the healthy functions; and, in reference to these several effects, are called *stimulants*, *sedatives*, and *alteratives;* the effects themselves being distinguished by the names of *stimulation*, *sedation*, and *alteration*. It has been maintained that, from the very nature of the vital functions, medicines can affect them in no other way than either by increasing or diminishing them, and that they differ from each other only in the degree in which they produce these effects respectively, or in the seat of their action. But this doctrine is purely hypothetical, and is opposed, apparently at least, by numerous facts. Nothing is more common than to witness peculiar effects from different medicines, without any observable increase or diminution of the vital functions; and this difference may often be observed in medicines acting on the same part. Besides, in relation to those which are essentially either stimulant or sedative, we observe characteristic peculiarities which cannot be ascribed either to the degree or direction of their action. Thus, in relation to medicines the effects of which are visible, we have intense redness with comparatively little tendency to vesication from mustard, a less degree of redness with large vesication from cantharides, a copious vesicular eruption from croton oil, a peculiar pustular eruption from tartar emetic, and the production of urticarious wheals from the nettle, all acting on the same portion of the surface, and all excitant in their operation. Now it is possible that, in these and similar cases, the result may be owing to the direction of the action of the irritants severally to some distinct constituent of the skin; but this has not been proved; and, in reference to a great number of the peculiar effects of medicines, such a direction to distinct constituents of the structure is altogether insusceptible of proof. In the present state of knowledge, therefore, it is best to admit, as the result of observation, that medicines do materially differ in the nature of their effects, independently of degree and position; and to leave to further investigation the determination of the precise nature of the causes which occasion such difference.

Another opinion denies the existence of directly sedative or alterative medicines, maintaining that all substances which act on the system are essentially stimulant, and that whatever sedative effects may be produced are purely secondary. According to one view, medicines operate on the vital excitability, producing primarily an elevation of action, which is followed by secondary depression in consequence of the exhaustion of the excitability; and whenever a direct depression takes place, it is in consequence of the diminution of the ordinary healthy excitants, as through the influence of cold, abstinence, etc. According to a second view, medicines operate as foreign bodies, offensive to the economy, in which, consequently, an excess of action is induced in order to rid it of the offending cause; in other words, all medicines operate by calling forth vital reaction, as inflammation is induced in a part by the presence of a foreign body, in order either to isolate it by a coating of coagulable lymph, or to throw it off through the agency of suppuration and ulceration. But in opposition to all such purely hypothetical views is the simple fact, that certain medicines, when brought into contact with certain parts or organs of the body, are immediately followed by a depression of function in those parts or organs, without any other discoverable intervening derangement; just as, under similar circumstances, certain other medicines are followed by immediate increase of function; and the obvious explanation is, that the susceptibilities of the parts are such that the presence of a body constituted in one mode occasions depression, that of another, differently constituted, excess of excitement.

But, admitting that some medicines are stimulant, others sedative, and others again alterative, we are not called on to believe that any one medicine is essentially one or the other under all circumstances. Much and very unnecessary discussion has taken place in relation to particular medicines, whether they were stimulant or sedative. It might all have been spared by the admission of the simple truth, that the same medicine may be stimulant or sedative according to the part upon which it acts, or the state of the system, or parts of the system, at the time of its action. Thus, tartar emetic is stimulant to the skin or mucous coat of the stomach, but sedative to the heart; digitalis, which depresses directly the circulation and nervous system, excites the kidneys; and opium, at the same time that it stimulates the heart and brain, diminishes secretion. These different primary effects of the same medicine are dependent on the different susceptibilities of the parts affected, rendering them liable to opposite impressions from the same cause; and, as these susceptibilities are often different in disease and health, the same medicine may produce opposite effects in these two states. Thus, Cayenne pepper, which produces in the healthy fauces redness and burning pain, acts as a sedative in the sore-throat of scarlet fever. A mere difference in the mode in which a medicine is employed may cause it to be either stimulant or sedative. A concentrated solution of acetate of lead applied to the skin denuded of its epidermis, or to a mucous membrane, acts as an irritant; while the same solution, very much diluted, will operate as a sedative through the peculiar powers of the medicine. This principle is of great importance in therapeutics, as will be hereafter more particularly shown.

The consideration of the special phenomena, whether of stimulation, depression, or alteration, produced by particular medicines or classes of medicines in the several functions, belongs to the department of special therapeutics. It is obvious that they must be extremely diversified, from the difference in the degree and nature of the action of the medicine, from its direction to one or to several functions at the same time, and from the great diversity in the character of the functions affected.

SECTION IV.

Influences Modifying the Effects of Medicines.

The circumstances which are calculated to modify the ordinary and characteristic action of medicines should always be taken into account by the physician. These may be divided into such as relate especially to the medicines, and such as relate to the system. The former will be more conveniently treated of when the medicines themselves are considered. A few general remarks, in relation to the latter, will be appropriate in the present place. To enter into minute particulars would be quite impossible; as there is scarcely a change, whether consequent upon the healthy progress of the body from birth to old age, or upon the operation of morbid causes, which does not in some measure influence the effects produced by medicines. Many of these influences will be referred to in connection with the several medicines or remedies described; but much, in practice, must always be left to the observation, experience, and judgment of the physician.

The modifying influences may be such as are essentially connected with our bodily constitution in health, or such as are more or less accidental. The first may be ranked under the heads of *age*, *sex*, *temperament*, and *idiosyncrasy*; the second under *disease*, *climate*, *habit*, *modes of life*, and *mental action*.

1. *Age.* It is a general, though not universal law of nature, that susceptibility to the influence of medicine is inversely proportionate to the size of the animal. This probably results chiefly from the greater amount of a medicine required to give a certain degree of impregnation to the blood of the larger animal than the smaller. The medicine acts on different bodies, not in proportion to its absolute quantity in the blood, but to the quantity of it which is brought to bear upon each point acted on, in other words, to the strength of its solution in the blood. Under the rule here referred to, the child should be more susceptible to the influence of medicines than the adult, and should consequently be affected by smaller quantities. But there is another reason, also, for the greater susceptibility of early life. In the growing state, greater impressibility and mobility are essential, in order that there may be a more rapid assimilation of external material, and a due arrangement of the organism. The higher susceptibility to impression must extend to medicines, as well as to all other impressing agents. Still another cause of difference, in this respect, between the young and the old, is the absence or less degree, in the former, of the influence of habit in diminishing susceptibility. I do not here allude to the habit of using medicines; for the cause operates though no medicine may ever have been taken. The general impressibility of the system diminishes by time under the necessary influence of external agents; and this law holds good even in relation to particular agents to which the system may never have been exposed, though it would be less operative in reference to these than to others.

It is impossible to give any precise rule for proportioning the dose to the age; because different individuals exhibit a great difference in this respect; and there is a remarkable diversity in reference to medicines;

some, as opium, producing in children more than the mean proportionate effect; others, as castor oil and calomel, much less. It may be said, in general terms, that the dose for an individual under maturity should be proportioned to the years of his age. This holds good in relation to all ages between 12 and 24, at the latter of which periods of life, the full dose may be given. From the age of twelve downwards to two years, the rule of Dr. Young is perhaps as good as any that can be given; namely, that the dose proper for an adult should be diminished, for a child, in the proportion of the age increased by twelve to the age. Thus, the age being three years, and the dose for an adult 20 grains, the diminution must be in the proportion of $3 + 12 = 15$ to 3; or, the quantities being reduced to their lowest terms, of 5 to 1; that is, the dose for the child must be one-fifth of that for the adult, or in the present instance 4 grains. At one year the dose may be one-ninth; at nine months, one-tenth; at six months, one-twelfth; at three months, one-fifteenth; at one month, one-twentieth; but it must be admitted that these numbers are nothing more than safe approximations. From full maturity to the commencement of declining life, that is, from about twenty-four to forty-eight, the dose may remain unchanged; but, after the latter period, it should be somewhat diminished with the increasing age, not because the system becomes more susceptible; for, as a general rule, it is less so; but because it is less able to sustain, without injury, a given impression from medicines than in the full vigour of life.

2. *Sex.* It is necessary to say but little under this head. There are certain conditions in the female which require attention in the prescription of medicines, which, however, cannot be said to exert any materially modifying influence over their effects, and do not, therefore, require particular attention in this place. Such is pregnancy, which demands especial caution in the use of all medicines having a direct influence on the womb, and which, in its advanced stages, contraindicates the use of any medicine whatever of a powerfully perturbating character. Such, too, is the menstrual state, in which care is required, in the employment of remedies, to guard against any interference with the uterine function. Another important point, of a similar bearing, is the caution requisite, in the cases of nursing women, not to use medicines which might injure the suckling; and a similar caution may be very properly extended to pregnancy, in which, while prescribing for the female, we should always bear in mind that there is another being to be affected by the remedy employed.

So far as concerns the modifying influence of sex upon the effects of medicines, the only circumstance of importance is, that women, being smaller, more delicately organized, and in general more susceptible than men, require a smaller amount to produce a given effect. The dose for females should, therefore, be somewhat reduced. From one-sixth to one-quarter may be deducted for them from the dose proper for the male at the same age.

3. *Temperament.* Temperament should receive some attention in the administration of medicines; but the judicious physician will probably be influenced in relation to it more by his general principles than by any special precepts. The sanguine temperament obviously demands caution in the administration of stimulants, and the nervous in that of evacuants; while the phlegmatic, being characterized by a general deficiency of susceptibility, admits and requires a freer use of medicines in reference to a given effect.

4. *Idiosyncrasy.* Individual peculiarity, technically denominated idiosyncrasy, is of much greater importance, and can scarcely receive from the physician a too careful attention. In very many individuals, perhaps it may be said in nearly all, there is some peculiarity, in relation to the effects of a particular medicine, or possibly of more than one, which, if unknown or neglected, may lead to serious inconvenience or injury, and even to fatal results. This peculiarity sometimes consists merely in an excessive susceptibility, or in an abnormal insusceptibility to the action of the medicine or medicines; so that an ordinary dose might, in the former case, act with dangerous violence, and in the latter not act at all. This is strongly illustrated in the not unfrequently unexpected results from the use of the mercurial preparations. In more than one instance that might be adduced, a moderate dose of calomel or other mercurial has acted so powerfully, in consequence of a remarkable constitutional susceptibility to its influence, as to occasion death; and every experienced practitioner, who has used this medicine habitually, must have witnessed instances of unexpected violence in its action; while, in other cases, from defective susceptibility, it is quite impossible to bring about its peculiar effects on the system by any quantity that can be given, with any regard to prudence. The instance of mercury has been brought forward simply as a striking example; but there is scarcely an efficient article of the materia medica, in relation to which there does not exist, in some one or more persons, a similar excess or deficiency of susceptibility.

But the idiosyncrasy is not unfrequently also of such a nature as to render the effects of a medicine altogether different from those which it ordinarily produces. The well-known and often-cited example of ipecacuanha, in causing by its mere smell an asthmatic paroxysm in certain persons, is strikingly illustrative of this fact. Other examples are offered in the cutaneous eruption produced in some individuals by copaiba and the turpentines, the irregular and very inconvenient effects sometimes resulting from opium, and the occasional peculiar and poisonous operation of mercury, altogether different from its proper action. I have known so innocent a medicine as pipsissewa (*Chimaphila umbellata*), given in the form of decoction, in the dose of a wineglassful, to cause a most violent attack of erythematous inflammation of the mouth and face.

These idiosyncrasies are sometimes also developed by disease, so as to render individuals susceptible to effects from medicines quite different from those expected, and sometimes even directly opposite.

Whether original or acquired, they should claim the careful attention of the practitioner, who should never neglect information in reference to such peculiarities that may be volunteered by the patient, and should lay up in his memory, for future use, all that he may witness in his own experience or observation. A physician thoroughly acquainted, from habitual attendance, with all the constitutional peculiarities of his patient in reference to the effects of medicines, often has great advantages in treatment over others without any experience of the kind.

5. *Disease.* Reference has already been more than once made to the influence of disease in modifying the effects of medicines. Not only is the susceptibility to their influence greatly increased in some instances, and greatly diminished in others, but new susceptibilities are occasionally awakened, and effects wholly abnormal, or at least apparently so, are experienced. Thus, inflammation of the stomach so much increases the susceptibility to the influence of emetics, that a minute fraction of the ordinary dose will often operate; while, in certain nervous affections, as delirium tremens for example, there is an almost equal diminution of susceptibility, and, in some instances, enormous doses are required to produce vomiting. In certain morbid conditions of the brain, a little opium will excite to phrensy; in others, it is with the utmost difficulty that the medicine can be brought to operate, as in tetanus and certain forms of mania. In diarrhœa, opium often checks the evacuations, in colic, on the contrary, favours the action of cathartic medicine. Certain conditions of disease have a powerful influence over the effects of medicines by impeding their absorption. Thus, any morbid state of the liver, which retards the circulation of the portal blood through that organ, must produce general congestion of the bowels, and consequently offer a strong impediment to the entrance of the medicine into the circulation. But, in this place, all that is necessary is simply to notice the modifying influence of disease, and to impress on the mind of the student the indispensable necessity of attending to it. The peculiarities in this respect of different morbid states, must be studied along with the several diseases in which, or the several medicines in reference to which, they are displayed.

6. *Climate.* Climate acts by altering the state of the system. Sometimes the change is so great as to amount to disease; and then the influence of this modifying cause is merged in that of the one last considered. But climate also affects the functions in a manner which can

scarcely be considered pathological; as the result is experienced more or less by the whole community; and, though the state of system under any particular climatic influence may be less vigorous, or less perfectly balanced, than under more favourable circumstances, it is nevertheless the health of that region where the influence prevails. The following may be mentioned as examples of the modifying influence of climate over the effects of medicine. In cold climates the susceptibility to alcoholic stimulants is much less than in the hot; probably because, in the former, much of the stimulant is consumed in the lungs for the production of heat, and thus thrown off from the system; while in the latter, in which heat is already in superfluity, none of the alcohol is consumed in the lungs, and more of it is consequently retained to act upon the brain. In hot climates, calomel acts less energetically on the liver than in cold, probably from the diminished general susceptibility of that organ, consequent upon its habitual over-excitement. In miasmatic districts, blood-letting and other evacuant measures are, in general, not so well borne as in regions exempt from malarial influence; while quinia may be given with a freedom which elsewhere might be hazardous. But the modifications produced by climate in the operation of medicines have not been investigated with sufficient accuracy and precision, to justify anything more than very general statements upon the subject.

7. *Habit.* This is a powerful agency. Its effect is almost uniformly to lessen the susceptibility to the influence of medicines, and thus to require an increase of their dose for the production of a certain amount of impression. In relation to medicines which are purely functional in their operation, this augmentation of the dose, under the influence of habit, may be carried on almost indefinitely. The quantities of alcohol and of opium to which the system may become accustomed, with present impunity, are enormous. It is not exactly the same with medicines of powerful chemical action, corrosive mineral substances for example; for, though the quantity may, through the agency of habit, be very considerably increased beyond what could be borne without its aid, yet, at a certain point, the chemical forces necessarily overcome the vital resistance of the tissues, and decomposition must take place. The mineral acids, therefore, the caustic alkalies, and the corrosive metallic salts, such as nitrate of silver, corrosive sublimate, and sulphate of copper, cannot be indefinitely increased without the danger of great organic mischief. But it must be remembered that, even with those acting functionally, the ultimate effects are in the highest degree injurious, either through chronic inflammation, induced at length by the constant irritation sustained, or by the failure of susceptibility to the ordinary vital stimuli, and the consequent loss of all power of action.

The rule in relation to the effect of habit in diminishing susceptibility is probably universal. There are, it is true, some apparent exceptions; as in the case of emetic substances, which often operate, on successive occasions, in successively diminishing doses; but the exception is only apparent; for the result in this case is ascribable not directly to the medicine, but to a diseased state of irritation produced by it, which itself is sufficient to induce vomiting. If an emetic substance is given at first in a small dose, and afterwards gradually increased, the stomach becomes accustomed to it, and very large quantities may be given without provoking vomiting.

The practical inferences from this effect of habit are, 1. that when it is desirable to maintain for a long time a given medicinal impression, the dose should be gradually, but at the same time cautiously increased, so as not too rapidly to wear out the susceptibility; 2. that when one medicine has been given so long as materially to impair its powers, another of analogous mode of action, but exerting its influence on a different tissue or part, should be substituted, until the susceptibility to the first returns; and 3. that, in omitting a medicine which has been long given in gradually increasing quantities, it should be withdrawn gradually, or its place should be supplied for a time with another of similar but feebler powers, lest the system or part should suffer from the want of an influence to which it had become habituated, and which might be essential to the performance of its proper functions.

8. *Modes of Living.* The occupation and mode of life of an individual modify the action of medicines, in so far as they affect the condition of his system. But it would be quite impossible, in the present place, to follow out this influence into all its results. Little more can be done here than to call attention to its existence. One consideration, however, is worthy of notice, as it has a general bearing, and can be brought forward nowhere else so appropriately. Firm and vigorous health affords the strongest resistance to all disturbing influences, and consequently to the action of medicines, which must, therefore, be given more freely, to produce a certain effect, than in conditions of the system either above or below that standard. This is true in relation not only to medicines which stimulate, but to those also which depress or alter the vital functions. Thus, persons in full health will bear both the stimulant influence of alcohol, and the sedative operation of digitalis, better than the plethoric or the feeble. But it must be remembered that full health does not consist in that richness and abundance of blood, and that high activity of the functions, which are sometimes mistaken for it. This is indeed a condition, if not itself morbid, at least closely bordering on disease, and capable of being excited into positive disease by slight causes. The system is most healthy when all its parts and all its functions are in due relation; when the quantity and quality of the blood are in exact accordance with the offices it has to perform in the economy; when the

nervous system has no higher nor lower activity than is sufficient to maintain every function in its just vigour and subordination; and when no one organ or apparatus is excessively or deficiently developed. It is in this condition of system that medicines are best borne, and that, upon the occurrence of disease, vigorous treatment may be most safely adopted. Modes of life, therefore, which tend to produce an over-elevated condition of system on the one hand, or a debilitated condition on the other, render peculiar caution advisable as to the quantity of medicines employed, and the energy of the treatment in general.

9. *Mental Action.* The influence of the mind over the operation of medicines is often very considerable. As a general rule, they will act with greater certainty when their legitimate effects are known and expected. An emetic will be more likely to vomit, if the patient anticipate this effect from it. The co-operation of faith with the medicine will often favour its action. This is more especially true when the nervous system is prominently concerned. The full belief in the efficacy of quinia in intermittent diseases aids considerably in the prevention of the paroxysm. But mental causes sometimes interfere with the regular operation of a medicine. When this is given to procure sleep, especially in divided doses, at certain intervals, if the patient is made acquainted with the object, his anxiety for the result may tend to prevent it. I have noticed, when I have directed, with the knowledge of the patient, a certain dose of opium to be given at bedtime, and repeated, at intervals of an hour, until sleep is produced, or a certain number of doses have been exhibited, that the whole quantity prescribed is generally taken. The nervous disturbance occasioned by the expectation of the next dose, and the watchfulness for the appointed time, tend to keep the patient awake. Hence, in prescribing an anodyne in this way, particular care should be taken that the patient shall not know that the dose is to be repeated if requisite. It is to mental influence that empiricism is partly indebted for its seeming triumphs, especially in nervous diseases; and regular practitioners sometimes employ bread pills, with the happiest effect, in accomplishing certain results which the patient has been previously taught to expect.

CHAPTER III.

Application of Medicines.

MEDICINES have hitherto been considered in relation, not so much to their application to the cure of disease, as to their modes of affecting the system in health. It now remains to consider them more especially in the former capacity; and, in doing this, it will be convenient to treat *first* of the several modes in which they may operate in the cure of disease, *secondly* of the forms in which they may be applied, and *thirdly* of the parts through which, and the means by which they may be introduced into the system. The remarks which follow apply not only to medicines strictly so called, but to all other remedies.

SECTION I.

*Modes of Therapeutic Action, or Therapeutic Processes.**

These may be arranged under the heads of 1. *depletion;* 2. *repletion;* 3. *dilution;* 4. *elimination;* 5. *stimulation;* 6. *sedation;* 7. *revulsion;* 8. *supersession;* 9. *alteration;* 10. *contra-causation;* 11. *chemical action;* and 12. *mechanical action.*

SUBSECTION I.

Depletion.

1. *Nature of Depletion.* By this term is here meant diminution of the blood, in relation either to the whole mass, or to some one or more of its constituents. As it is these constituents of the blood to which,

---

* The reader who may be familiar with my Treatise on the Practice of Medicine, in any of its editions before the fifth, will recognize, in the observations which follow, many things which he has met with in that work. These were not introduced into the present treatise inadvertently. They essentially belong to it, and could not be omitted without leaving the treatise imperfect. Their insertion here, moreover, gave me the opportunity, in revising the work on the Practice for the fifth edition, of dropping in the revision the subjects here treated of, and supplying the space thus gained with new matter of a practical nature, which is ever in the course of discovery and accumulation.

both through the material they furnish, and the stimulus they apply, all the vital functions owe their support, and the organs their due nutrition, the abstraction of them must necessarily occasion, in the ordinary state of the system, a depression of action and reduction of strength. It is not only, however, by diminishing the quantity of blood that depletion operates, but also by altering its quality. When a portion of the blood is abstracted, the place of the solid constituents withdrawn is rapidly supplied by the process of absorption, so that its former volume is soon restored; but, as water is absorbed in much greater proportion relatively than the solid ingredients, the blood becomes diluted, and is, therefore, less capable of performing its due office in the economy. Depletion depresses especially the force of the heart, and of the whole circulatory system. It diminishes also digestion, respiration, secretion, nutrition, calorification, and the functions of animal life. This last effect is rendered obvious when the depletion is carried far. Languor, impaired sensation, deficient emotional and intellectual energy, muscular weakness, even faintness, and positive syncope, result from the failure of the due influence of the blood upon the brain.

But, with this general diminution of the vital powers and actions, there is one function which depletion promotes, that, namely, of absorption. To supply the loss of blood, the liquids and solid tissues of the body are taken up with more than the usual rapidity, and water is copiously absorbed from the contents of the alimentary canal, and perhaps also from the external air.

Notwithstanding what has just been stated, depletion is not always purely sedative; and this is a very important therapeutical fact. The general rule may be considered as holding true, whenever the blood is in excess as regards its animalized or vital constituents; also, in the ordinary state of the blood, so far as concerns the immediate effects of depletion, and even in its ultimate effects when it is moderately used and properly guarded. But excessive depletion may act as an excitant instead of a depressing agent to certain functions, and especially those of the circulatory and nervous systems. The functions of the system generally, feeling the want of their ordinary support from the blood, make this want known to the nervous centres, which then transmit a stimulant influence to the heart, while, at the same time, they give evidence of their own disturbance by various irregular nervous phenomena. Under no circumstances, is the heart thrown into more violent commotion than, sometimes, through an impoverished condition of the blood. Depletion, therefore, especially the more direct and powerful kinds of it, should be employed with reserve in anemic states of the circulation, even though strongly indicated by other considerations. Another important rule is that, when a purely sedative effect is desired from this remedial measure, all the functions should be kept as quiescent as possible; so that, consuming little blood, they may not, from a feeling of deficiency, excite the nervous centres and through them the heart into a state of irritation. Rest should be enjoined, the food diminished, and strong mental action or emotion avoided; so that the muscles, the digestive organs, and the brain may be content with less than the ordinary supply of their essential pabulum.

2. *Applications of Depletion.* The therapeutic applications of depletion are obvious. It is the great remedy in plethora, and in an excess of local vascular excitement, whether that excess amount to irritation merely, or to inflammation. Sanguineous determination and active congestion, hemorrhage, morbidly increased secretion, and other derangements of function, so far as these disorders are the result of vascular irritation, are to be corrected by it. In the treatment of inflammation it is invaluable, not only lessening the force with which the blood is driven into the inflamed part, but impairing those qualities of the vital fluid which most powerfully support that morbid process.

Another application of depletion, dependent on its influence over the absorbent process, is to the treatment of morbid effusions; the different forms of dropsy, for example, in which it is often employed with great efficacy, though requiring caution. Upon the same principle, it may be used in polysarca or morbid obesity.

3. *Means of Depletion.* Depletion may be effected either directly, by taking blood or promoting secretion, or indirectly, by diminishing the supplies through which the natural losses of that fluid are repaired.

Direct Depletion. Beyond all comparison the most efficient of the measures for direct depletion is *general* and *local bleeding.* The character of this remedy, its peculiar applications in disease, and the methods of employing it, will be fully considered in the second part of this work.

Another important mode of direct depletion, is *increased secretion.* It not only unloads the circulation in general, but, in some cases, has the advantage over bleeding, of directly depleting from the diseased vessels themselves, and thus imitating a very frequent process of nature in the relief of irritation and inflammation. Thus, cathartics relieve mucous enteritis, expectorants bronchitis, and diuretics nephritis. It is not merely the watery parts of the blood that are thus evacuated, but its animalized constituents also, though the red corpuscles seldom pass. Upon the whole, this mode of depletion is much less efficacious than bleeding, in the relief of plethora and active congestion. But, for the purpose of promoting the absorption of effused fluids, it is even more efficacious; as a much larger amount of liquid may be safely abstracted from the blood-vessels by increased secretion than by bleeding, and consequently a greater amount of absorption produced.

The remedies most efficaciously employed with reference to depletion, upon this principle, are cathartics, diuretics, and diaphoretics. But all that increase secretion are occasionally useful, including expectorants, emmenagogues, sialagogues, errhines, epispastics, issues, and setons. It is upon this principle, in part, that the warm, hot, and vapour baths act usefully in certain inflammatory affections. In the application of these various remedies there is much room for discrimination; some being better adapted to one condition, others to another, and some being positively injurious where others are highly useful. This, however, is not the proper place to discuss their properties; and the reader is referred to the second part of the work. It may be proper to mention here, that such as are employed for the reduction of plethora, or inflammatory excitement, should be destitute of general stimulating properties, and that the most efficient are those which unite a sedative influence over the circulation with the power of increasing secretion. Such especially are the saline cathartics, and the antimonial diaphoretics and expectorants. A general rule applicable to all these medicines is, that, in cases of high vascular excitement, when the pulse is full and strong, and bleeding is otherwise indicated, they should be preceded by that remedy. Secretion is often checked by excess of excitement in the secreting organ, and favoured by a reduction of the excitement. Besides, medicines are not easily absorbed when the blood-vessels are full to distension. If the object be to reduce active congestion or inflammation by promoting secretion from the part or organ affected, preference should always be given, at least in the earlier stage, to those stimulants of the secretory function which are least irritant in their action. Thus, sulphate of magnesia should be preferred to gamboge, scammony, or elaterium, in the treatment of dysentery; tartar emetic or ipecacuanha to squill or seneka, in the earlier stage of bronchitis; and cream of tartar to oil of turpentine, in acute nephritis.

Indirect Depletion. This is effected by whatever prevents the usual amount of solid organic material from entering the circulation. Emetics and cathartics act in this way, by discharging the partially digested food from the alimentary canal before it has been absorbed. Still more efficacious is a temporary abstinence from food, or a reduction of its quantity and quality. But the subject of *diet* as a means of indirect depletion belongs to special therapeutics, and will be considered hereafter.

SUBSECTION II.

Repletion.

This term is here employed, rather in reference to its origin than in accordance with its accepted meaning, to signify an increase in the quantity of the blood in general, or of its solid animalized ingredients. The circumstances of disease under which this remedial process is desirable are the opposite of those requiring depletion; namely, general debility, a too scanty blood, and a condition of that fluid in which, though its bulk may be sufficient, there is an undue proportion of the watery ingredient. The means by which it may be accomplished are the free employment of a highly nutritious diet, and the use of remedies calculated to invigorate digestion and sanguification, such as moderate exercise, tonic and stimulant medicines, frictions, and the cold bath.

SUBSECTION III.

Dilution.

By this is meant the copious internal use of water, whereby the liquids of the body are diluted, and rendered less excitant. The contents of the stomach are first diluted, then the blood through absorption of the water, and lastly, the secretions, especially those of the skin and kidneys, in consequence of its passing out through these emunctories. The therapeutic effect is to relieve irritation or inflammation of the surface with which the diluted fluid may be in contact, as the mucous membrane of the stomach, and that of the urinary passages, and to moderate general excitement by attenuating the blood.

SUBSECTION IV.

Elimination.

It is well known that, in the course of various diseases, matters accumulate in the blood, either altogether foreign to that fluid, or existing in it during health only in almost inappreciable quantities, and in the course of spontaneous elimination from the system. Thus, urea and uric acid, which are the results of the disintegration of the tissues, or the superfluous residue of the food in its conversion into blood, are, in the healthy state, present in the circulation only until they can be thrown off by the kidneys; and the same may be said of the colouring matter of the bile, which is separated and excreted by the liver. These accumulate abnormally in the blood, when their respective emunctories fail in their office of excretion, and become sources of inconvenience and danger. It is highly probable that other noxious principles, not well understood, in like manner vitiate the blood, either forming special diseases, or complicating those resulting from other causes. In febrile complaints, a sour odour is often observable in the breath and perspiration, arising from the escape of acid matters from the blood. In typhus fever, smallpox, and many cases of disordered digestion and obstinate constipation, the breath and other secretions have an offensive odour, indicating, no doubt, an impure condition of the circulating fluid. Now the existence of such morbid matters in the blood affords a well-grounded indication for the use of remedies calculated to effect their elimination; and there can be no doubt that this is not unfrequently a very useful therapeutic process. The remedies alluded to are such as stimulate the several emunctories; and cathartics, diuretics, diaphoretics, and cholagogues, add this mode of action to their other beneficial influences in disease.

There is another mode of elimination which has recently begun to attract attention, and which may possibly hereafter prove a highly important method of cure. It has been shown that certain substances, having a noxious influence upon the health, are sometimes incorporated with the tissue of the organs, and probably thus impair their efficiency by a constant unhealthful influence. Such are various metallic poisons, as the preparations of arsenic, lead, copper, and mercury. To separate these from their seat in the tissues is an important indication; and there is reason to believe that this may sometimes be fulfilled, not only by medicines calculated to promote absorption and secretion, or to alter the nutrition of the organ, but also by others which modify the condition of the foreign matter, so as to render it soluble in the blood, and thus capable of being eliminated from the system. It is believed, for example, that lead is thus displaced, when producing colica pictonum or paralysis, by the exhibition of iodide of potassium. More will be said on this subject under the head of the several remedies employed on the principle referred to.

SUBSECTION V.

Stimulation.

Stimulation, as here understood, is the exaltation of any or of all the vital functions above the state in which they may happen to exist, at the time when the stimulating measure is resorted to. There is a vast diversity in this process. It differs in direction, degree, duration, and character. Perhaps the most convenient primary division of it is into *general* and *local;* the former being felt, to a greater or less extent, throughout the body, the latter confined originally to a particular part or organ.

A property common to all stimulation is, that it is followed, in the ordinary state of the system, by a degree of depression bearing some proportion to the previous excitement. There are conditions of temporary prostration, in which stimulation may put the system in the power of resuming its ordinary grade of action without subsequent depression; but these do not come within the general rule. The depression is dependent upon the temporary diminution of excitability, resulting from excessive action. If the stimulant influence be continued, it follows, as a consequence of the diminished excitability, that a greater amount of the stimulant agent must be employed to produce the same effect, and the excitability is thus still further diminished; until, in the end, the system refuses entirely to respond to the ordinary healthy excitants, and morbid and often fatal debility results. This is an evil against which it is necessary to be constantly on our guard, in the use of stimulant measures. Another, scarcely less important, is the production of inflammation by the excessive or repeated excitement to which the stimulated organ or system is exposed.

1. *General Stimulation.* It is barely possible that stimulation should be absolutely universal. In whatever degree the functions generally may be excited, there is almost always some one or more that become depressed, or remain quiescent. Stimulation may be considered general, when any one of the vital properties or functions which belong to all parts of the frame is exalted, as contractility or nutrition; or when one of the anatomical systems which pervade the whole body is excited into increased action, as the circulatory or nervous. In such cases, the excitement is felt throughout the frame, though not in every function.

The lowest grade of general stimulation is that produced by *astringents,* which operate on the organic contractility, and produce a general condensation or shrinking of the tissues. Tubes and orifices are thus contracted, the flesh becomes firmer, and the pulse somewhat more tense. The therapeutic applications of this power of astringency, with the requisite cautions, will be hereafter fully considered.

Somewhat higher in the scale of general stimulation is the action usually denominated tonic. This is a moderate increase of the vital functions generally, produced rather slowly, and lasting for a considerable time. It is of vast importance in the treatment of moderate or chronic debility. For an account of its special applications, the reader is referred to the second part of the work. Among the agents by which it is effected is a class of medicines denominated *tonics,* which may act directly on the whole system, or especially on the digestive function, thereby enriching the blood, and making that fluid the immediate excitant. Some medicines probably also give tonic power to the blood by a direct action on that fluid. Such are the chalybeates. But there are other very important tonic agents besides medicines. *Cold* operates in this way secondarily, through the reaction which follows its direct depressing influence. A *wholesome and nourishing diet,* succeeding an impoverished one, and *pure fresh air* with those who have been confined to a close and vitiated atmosphere, have a powerful tonic operation. So also has moderate *physical exercise,* under similar circumstances of previous deprivation. *Gentle electrical excitation* may be placed in the same category. *Mental influences,* moreover, have great effect. No tonic is, under many circumstances, more efficient than the cheering influence of social pleasures, domestic enjoyment, and a gentle exercise of the intellectual faculties, and all the kindlier emotions.

A quicker and more rapid stimulation is sometimes distinguished by the name of *diffusible*. It usually affects more or less, at the same time, the functions both of organic and animal life; though, as proceeding from one cause it may be more especially felt in the circulation and its dependent functions, from another, in the nervous system. This special direction is sometimes so far exclusive as to justify the division of diffusible stimulants into those operating more particularly on the circulation, and those upon the cerebro-spinal functions. It will be found, hereafter, that this distinction serves as the basis of an arrangement in the plan of classification which I have adopted. For want of a better name, the medicines acting on the circulation especially, with little tendency to the nervous system, may be denominated *arterial stimulants*.

Stimulants which act chiefly on the nervous system may diffuse an apparently equable action over the whole of that system, or may concentrate their influence especially on the brain. The former may be called *nervous stimulants*, though more commonly designated as antispasmodics; the latter I propose to call *cerebral stimulants*, preferring this title to that of narcotics, which has reference to the property of stupefying, that belongs also to medicines of wholly different powers. It will be perceived hereafter that the above arrangement of stimulant medicines is not only natural, in relation to their physiological effects, but has also an important practical bearing.

Other influences besides those properly medicinal are susceptible of very useful employment in reference to general stimulation. *Heat* and *electro-magnetism* are agencies of this kind; and *stimulating food* is yet more important. These will be fully treated of under Special Therapeutics.

2. *Local Stimulation.* Local stimulation may have the effect of merely irritating or inflaming a part; or of exciting it to an increased performance of its peculiar function.

In the former case, the object is usually to act revulsively, or to produce general stimulation through the sympathy of the system with the part affected. The agents employed for either purpose, so far as the external surface is concerned, are the rubefacients, epispastics, and escharotics. Occasionally, however, the object is entirely local. The vessels of a part may become relaxed and congested with blood, and, in consequence, an imperfect sort of inflammation may be sustained; or there may be ulceration, and the surface too feeble to take on the action necessary for the healing process. In either case, local stimulation sometimes answers an excellent purpose in removing the evil.

But still more frequently this remedial process is employed for the increase of function. The surface may be pale, dry, and inactive; the muscles may be enfeebled to paralysis; the senses of smell, taste, and touch may be imperfect from weakness; digestion may be feeble, and the bowels costive from deficient secretion, or want of due peristaltic movement; the liver, kidneys, or other secretory glands may be inert. The means used to restore the weakened functions are medicines and other remedies, having a special influence over the functions severally. Hence the use of friction to the surface; the hot bath; the cold bath used with a view to reaction; diaphoretics; errhines; masticatories; gastric stimulants, such as bitters, aromatics, and the mineral acids; emetics; cathartics; diuretics; expectorants; emmenagogues; and cholagogues to excite the liver, as mercury and nitromuriatic acid. Hence the employment of ergot to stimulate the uterus to contraction.

Sometimes a local stimulant is employed to produce general depression; as in the case of the hydragogue cathartics, which, though they stimulate the secretory function of the bowels and promote the peristaltic movement, depress the system in consequence of the depletion they produce.

SUBSECTION VI.

Sedation or Depression.

This implies a diminution of action. Like stimulation it may be general or local. *General sedation* may affect especially either the circulation and its dependent functions, or the nervous system. The agents which produce the former effect I denominate *arterial sedatives*. They are the refrigerants of other writers; as they reduce temperature along with vascular action. Those operating upon the nervous system may produce their depressing effect in two ways; in one, by directly affecting the functions of the nervous tissue wherever they encounter it; in the other, by acting primarily on the brain, and through the cerebral centres depressing the dependent nervous functions. The former may be called simply *nervous sedatives*, the latter may be distinguished by the title of *cerebral sedatives*. It is important to understand that general nervous sedation may result even from the cerebral stimulants, through this dependence of function. In this case, the nervous centres are overwhelmed by an active congestion, which cripples their power both of receiving impressions and transmitting influence; and sensibility, muscular motion, and in fact all the functions which derive a necessary support from the brain are more or less impaired. This distinction is of great practical value. Thus, hydrocyanic acid, tobacco, and acetate of lead might be used as sedatives, when it might not be altogether safe to employ alcohol or opium.

The agents of sedation will be enumerated and described hereafter. It is here sufficient to say that, besides sedative medicines, we are in possession of two powerful remedies of this kind; viz. *cold*, in relation to its primary effects, and *water*.

Local sedation may affect all the constituent tissues of a part, or more especially the nervous. In the former relation, it is employed to repress inflammation, or vascular irritation as shown in morbid secretion, hemorrhage, or simply congestion; in the latter, to relieve neuralgic pain, and allay spasm.

Many of the general sedatives may be employed locally for these purposes.

SUBSECTION VII.

Revulsion. Derivation. Counter-irritation.

Revulsion consists in the diversion of disease from one part of the system, by the production of inflammation or irritation in another part. The term *derivation* is applied to the same process, but may be extended also to cases in which the diversion is effected by a degree of excitement, which may still be within the limits of health. *Counter-irritation*, strictly defined, applies to the revulsive impression rather than to the revulsion itself. The system has only a certain capacity of nervous action, and a certain amount of blood. When either the former or the latter is strongly directed to a particular part of the body, there is a tendency to its diminution elsewhere. This is absolutely necessary of the blood; and it is true, to a great extent, in relation to nervous action. Such a direction is given by the application of irritants of any kind. Hence, in order to relieve inflammation, any of the forms of vascular irritation, or mere nervous disorder as indicated by pain or spasm, in any particular part of the body, we apply irritants, which under these circumstances are called revulsives, to some other part. This principle is of very extensive applicability to the cure of disease. It often comes into play as an auxiliary force, in cases in which the remedy is used for other purposes. Thus, while emetics are employed to relieve spasmodic affections of the air-passages, in consequence of the relaxation they produce, they are probably also useful by a revulsive influence towards the stomach. Cathartics act very powerfully, upon this principle, in the relief of inflammations and active congestions, though they may be employed chiefly in reference to their depleting power. There is no remedy whatever, allowing it to have the power of producing excitement in any part of the body, which may not act as a revulsive. But the remedies usually employed, in special reference to this principle of action, are external irritants, such as hot water, rubefacients, epispastics, and caustics. Derivation may often be advantageously effected by exercise, calling off undue excitement from internal organs to the exterior, or from one part of the body to another, and thus producing an equilibrium of the vital actions.

The application of the principle of revulsion requires discrimination.

When the local affection consists rather in a determination of blood to the part affected than in inflammation, as in cases of vertigo threatening apoplexy, and of frequently recurring epistaxis or hæmoptysis, the indication is to divert the general current of excitement, and of the blood, towards the most distant parts of the body. Hence the use of strongly stimulating pediluvia, and of sinapisms to the legs, in cases of cerebral affection of the character just alluded to. But, when the disease is fixed in a part in the form of inflammation, it is necessary to bring the revulsive impression into nearer contiguity with the diseased part, though it may be proper also to employ remote revulsion as an adjuvant. Hence, in inflammation of the lining membrane, or of the contents of the great cavities, the revulsive remedy is most advantageously applied over the outer surface of the walls of those cavities, as over the abdomen in cases of peritonitis or enteritis, the chest in cases of pleurisy or pneumonia, and the scalp in those of encephalic inflammation.

The revulsive influence of remedies is peculiarly indicated in cases of metastasis, or of diseases which are especially liable to assume the metastatic form. In these cases, the agent should be applied to a portion of the body towards which there is a natural tendency of the morbid action to flow, and in which it would be safe; as, in gouty cases, to the feet, and in retrocedent eruptions, to the part of the surface from which the retrocession has taken place.

Another important principle is not to employ a highly irritative revulsive agent, in inflammatory cases, during the greatest violence of the disease. A strong impression upon the surface may sometimes prove useful in a commencing inflammation, before any febrile action has been excited, and in the declining stages, when the fever has in some measure yielded to depletion, or subsided spontaneously. But, during the existence of high constitutional excitement, the revulsive agent is not sufficient to unseat the inflammation, and, if itself very irritant, as in the instances of the more powerful rubefacients and of blisters, may add to the existing excitement by the sympathy of the system with the superficial inflammation it produces. But, when the revulsive impression is conjoined with copious depletion, as in the case of the saline hydragogue cathartics, which produce a revulsion towards the whole lining membrane of the bowels, while they evacuate the contents of the blood-vessels, it may be resorted to in the greatest height of the inflammation. The copious secretion prevents the production of an intestinal irritation sufficient to bring the constitution into sympathy.

When the local affection to be remedied is a mere nervous irritation, such as spasm or neuralgic pain, it is generally best to produce a quick, powerful, and transient revulsion; when inflammatory, especially when the inflammation is severe, to sustain a more moderate impression for a longer time. Hence, the more active rubefacients, such as mustard and ammonia, are applicable in the former case, and epispastics in the latter.

SUBSECTION VIII.

Supersession or Substitution.

By this process is meant the displacing or prevention of one affection by the establishment of another in the seat of it. It is a general, though by no means universal pathological law, that two powerful diseases, or forms of abnormal action, cannot exist in the whole system, or in any one part of it at the same time. If, therefore, we can produce a new disease, or new mode of abnormal action, in the exact position of one that may be existing or expected, we may possibly supersede the latter; and, if the new disorder subside spontaneously without injury, we cure our patient. The operation of numerous remedial agents may be explained in this way. It is thus, for instance, that mercury has been supposed to cure syphilis. But we have better examples in the powerful influence of certain antiperiodic remedies, such as quinia and arsenic, in the cure of intermittent diseases. They establish their own morbid impression in the absence of the paroxysm; and the system, being thus occupied at the moment when the disease was to return, is incapable of admitting it. In the same way may be explained the effects of blisters, opiates, emetics, or indeed any violent impression from any source, in the cure of paroxysmal diseases, if caused to be in full action at the time of the expected recurrence of the paroxysm.

Mental influences are sometimes very powerful in the superseding not only of intermittent diseases, but of continued disease also, when of a merely functional character. The excitement of any strong emotion may have this effect; and the pre-occupation of the nervous system resulting from a strong faith has often exhibited a wonderful influence.

The same law holds in cases of purely local diseases. It is probable that many cutaneous eruptions, and diseases of the mucous membrane of the alimentary canal and urinary passages, yield, upon this principle of supersession, to certain applications made to them directly, or, in the case of urinary diseases, through the route of the circulation.

SUBSECTION IX.

Alteration.

This name may be given to that operation of medicines by which they change existing morbid actions or states, without any observable effect on the system to which the result could be ascribed. The medicines are usually called alteratives. They may produce their effects by changing the character of the blood, or the condition of the solids. Their precise mode of action is unknown, or at best conjectural. It will be perceived that the employment of the term is merely a convenient mode of classifying certain unintelligible results, which depend altogether for their acceptance upon the evidence of observation. In certain states of disease we administer certain remedies, without other observable effect than a cure. It is often very difficult, in such cases, to decide whether the result has proceeded from the remedy, or has happened in the ordinary course of the disease. It is at least highly probable that a great many medicines have acquired a credit as alteratives, which was due exclusively to nature.

Among the most striking illustrations of this operation of medicines is that of mercury in the cure of inflammation. After due depletion, or when depletion is not indicated, no remedy has so powerful an antiphlogistic influence as mercury, urged to the point of affecting the system. Other examples are offered by iodine in scrofula, sarsaparilla in venereal disease, colchicum in gout, etc.

It is apparent that supersession and alteration may often lay claim to the same results. Thus, does mercury cure syphilis and inflammation by the substitution of its own transitory morbid effects for the existing disease, or does it merely alter the morbid into healthy action? Upon the solution of this question it depends, whether the remedy is to be looked upon as a supersedent or an alterative.

SUBSECTION X.

Contra-causation.

I use this term to express that operation of a remedy which consists in the cure of a disease by the removal of its cause. It very often happens that one morbid state depends upon another; and the cure of the latter, by any process whatever, results in the cure of the former. This is not, however, the influence to which allusion is here made. To bring any case under the present head, the cause must not itself be a disease, and the remedy removing it must do so by a special agency. Thus, antacids cure headache by neutralizing acid in the stomach, which produces the headache. An emetic will cure spasm of the stomach caused by indigestible food by evacuating the offending matter, and cathartics often relieve colic on a similar principle. An alkaline carbonate will relieve irritation of the urinary passages dependent on the precipitation of uric acid, and certain acids the same condition produced by the presence of undissolved phosphates; each operating on the offending cause by neutralizing it, or rendering it soluble. Anthelmintics cure various disorders, dependent on worms in the bowels, by destroying or expelling the worms. In like manner, the class of parasiticides act by destroying the microscopic parasites, whether animal or vegetable, which infest the skin and various internal structures; and under the same head may be classed the remedies which render inert or destroy those poisonous agents, now generally believed to be organized beings, which, entering the circulation, and there acting as ferments, give rise to the various zymotic diseases.

SUBSECTION XI.

Chemical Influence.

This might, perhaps, be included in some one or more of the processes already referred to. Substances may be employed therapeutically, in reference to their chemical influence, for three purposes; *first*, for the destruction of the tissues, as in the formation of issues, the removal of morbid ulcerated surfaces, etc.; *secondly*, for the neutralization, or other chemical change of substances contained within the body, but not forming an essential part of it, as when excess of acid in the primæ viæ, the blood, or the urine, is obviated by alkalies, or an insoluble metallic combination in the tissues is rendered soluble by the chemical agent administered; and, *thirdly*, through their reaction with the constituents of the blood or of the tissues, to produce changes in them favourable to the removal of disease. But their influence in all these methods of action may be resolved either into contra-causation, elimination, or alteration; except in the formation of issues, in which instance the chemical action is not in itself curative, but simply operates by setting on foot certain physiological processes which constitute the real remedy in the case. In relation to the process of alteration, it is highly probable that, in many instances, it is purely the result of chemical reactions set on foot by the remedy in the interior of the system; but we have little positive knowledge upon the subject, and theoretical speculations can lead to little practical good, except in so far as they may serve as a guide to inquiry and experiment. They should not be allowed to serve as the basis of curative methods, until the chemical reactions have been experimentally traced out, and demonstrated beyond reasonable doubt.

SUBSECTION XII.

Mechanical Influence.

This is often very important in the treatment of disease. Upon careful examination, however, of its effects, it will be found in general to act upon some one or more of the principles already considered. The following are the different modes in which this kind of influence may be remedially employed.

Position may be made to favour or counteract, through the agency of gravitation, the entrance of blood into a part. Thus, when fainting is threatened from a want of the due pressure of the blood upon the brain, by placing the patient in a horizontal posture, the pressure is favoured, and the apprehended result prevented. Much more frequently, however, the object is to diminish congestion or inflammation in a part, by diminishing the access of blood; and this is accomplished by elevating the part affected above its usual position. Thus, in an inflamed limb, the extremity should be raised, instead of being allowed to retain its ordinary dependent position of health. It is clear that the remedy operates, in the latter of these cases, upon the principle of local depletion, and in the former, upon that of local repletion. Position is occasionally useful in other modes, as in obviating intussusception of the bowels, in favouring the passage of calculi, in relieving painful pressure or tension, etc.

Compression is another useful mechanical process, which may be made to diminish or increase the quantity of blood in a particular part of the body, and thus to accomplish in some degree the same object as the former remedy. Thus, the access of blood to a part may be lessened or cut off by pressure upon the arterial trunks which supply it; or the capillaries themselves may be emptied by direct and equable pressure made upon them. In the latter mode especially, much good is often done in obstinate inflammation and passive congestion. An accumulation of blood may be produced by pressure upon the veins, and not upon the arteries, as when the tourniquet is applied not very tightly. This process may sometimes be useful by abstracting temporarily a quantity of blood from the general circulation, without its ultimate loss. It is a mode of general depletion. Compression upon nervous trunks has been used as an anæsthetic agent in surgical operations. Other advantageous effects of this agency are to promote absorption, and to afford mechanical support to relaxed parts, as in varicose veins of the legs, and to the abdomen after the operation of tapping.

Distension sometimes also operates usefully by stimulating a part to increased action; as when large fluid injections are thrown up the bowels. It may, however, be carried so far as to produce paralysis of the muscular fibres, and thus to prevent all contraction. This is an important therapeutical fact. Distension is used to enlarge passages, strictured or otherwise, as by means of bougies; and substances are also used for this purpose which swell when they become moist, as compressed sponge, slippery-elm bark, and gentian root.

Friction may be considered as a mechanical remedy. It acts partly by compression, partly by stimulation. Employed for the latter effect, it is often a powerful agent in rousing and supporting the system in low disease, and in exciting the part itself when enfeebled; but it is more frequently and usefully employed for its effect in producing revulsion from within outwardly.

The *covering* of surfaces, so as to protect them against irritating substances, and the contact of the air, is another useful mechanical process. Thus, demulcents protect inflamed mucous surfaces; and collodion, cataplasms, plasters, cerates, and thin layers of gutta-percha and caoutchouc, are applied for the same purpose to the skin. It is not improbable that the effect of nitrate of silver and iodine, in subverting superficial inflammation, may be partly owing to a chemical change in the epidermis, rendering it less pervious to the air. How the exclusion of the air proves useful it is not easy to determine. Perhaps it may be partly by maintaining the moisture which would otherwise be evaporated; perhaps, as suggested by Dr. Latour, by diminishing calorification to which the presence of the air may contribute, if it be not essential (*Archives Générales*, 4e sér., xxvii. 237); or, possibly by preventing any direct influence which the atmospheric oxygen may have in supporting the inflammatory process.

SECTION II.

Forms in which Medicines are Applied.

Medicines are used in the solid, liquid, and aëriform states. In the solid state, they are employed, internally, in the several shapes of *powder*, *electuary*, *conserve*, *pill* or *bolus*, and *lozenge*: and externally, of *cataplasm*, *ointment*, *cerate*, and *plaster*. In the liquid state they are either originally liquid, or rendered so by *mixture* or *solution*. In the aëriform state they have the form either of *gas* or of *vapour*. For ample details upon each of the solid and liquid forms mentioned, the reader is referred to the U. S. Dispensatory. It will be sufficient, in this place, to make a few general observations, calculated to facilitate to the learner the study of the practical application of medicines which is to follow.

SUBSECTION I.

Solid Forms.

1. POWDERS (*pulveres*) are medicines finely comminuted by the processes of pounding, grinding, levigation, elutriation, precipitation, etc. This is a convenient form for the administration of insoluble substances, not very disagreeable to the taste. It is unsuitable for deliquescent substances, as carbonate of potassa, and for combinations consisting of ingredients which become liquid or semiliquid by chemical reaction, as is the case when acetate of lead is mixed with sulphate of zinc. Light powders, readily miscible with water, may be given diffused in that liquid,

either pure, or rendered more agreeable to the taste by sugar and aromatics. Resinous powders, in order to be diffused, require that the water should be rendered somewhat viscid by saccharine or gummy additions. Heavy powders, as the metallic, are more conveniently exhibited in the form of electuary.

2. **Electuaries** (*electuaria*) are preparations in which the medicine is brought into the condition of a soft solid, and may be conveniently made by mixing powders, extracts, etc., with syrup, molasses, or honey. They are included among the *confections* in the U. S. Pharmacopœia. Liquids may be brought into the same condition by admixture with sugar and gum. Any medicine may be exhibited in this form which is not too bulky, or too offensive to the taste. In forming powders into electuaries, the proportion of the semiliquid vehicle must vary with the nature of the article used. Thus, dry vegetable powders usually require twice their weight of syrup, gummy and resinous powders an equal weight, and the metallic a still smaller proportion. In the last case, it is well to add a small quantity of some conserve; as the tenacity of syrup or honey alone is scarcely sufficient to prevent a separation, by the subsidence of the heavier ingredients.

3. **Conserves** (*conservæ*) are preparations in which fresh vegetable substances are beat up with sugar, as well for the sake of preservation, as for convenience of administration. They are included, along with electuaries, under the *confections* of the U. S. Pharmacopœia. Very few medicines are exhibited in this way.

4. **Pills** (*pilulæ*) are small, spherical, solid bodies, of a convenient size for swallowing. Medicines of which the dose is small, and the taste disagreeable, may be appropriately given in this form; but it is not suitable for deliquescent substances, nor, indeed, for those which are copiously efflorescent, unless previously deprived of their water of crystallization. Hence, when carbonate of soda or sulphate of iron is given in pill, the dried salt, from which the water of crystallization has been driven off by heat, should be preferred. Care should be taken, in prescribing a substance in this form, that the adjuncts should be such as not to render it too hard, and of difficult solubility in the liquors of the stomach. As a general rule, pills recently made are preferable to the old, as being softer and more soluble; but occasionally, when the object is that the medicine should act very slowly, and consequently that it should be slowly dissolved, old and hard pills may be advantageously administered. The weight of the pill, if composed of vegetable substances, should not generally exceed three or four grains; if of metallic ingredients, it may be from four to eight grains. It will sometimes be useful, when the ingredients of the pill are very offensive to the smell or taste, to give it a coating of some material, either tasteless or not disagreeable, which may be readily dissolved in the stomach. Gelatin and sugar answer this pur-

pose very well, and are easily applied. Gold leaf, formerly employed, is objectionable from its insolubility.

Boluses are preparations similar to pills, but larger, and may be preferably used where the dose is large, and the patient can swallow them without difficulty. Their size is limited only by the patient's capacity of deglutition.

5. LOZENGES, or TROCHES (*trochisci*), are solid masses of various shape and size, which may be conveniently held in the mouth, and there allowed slowly to dissolve. They are adapted for the administration of medicines of agreeable taste, or of which the taste, if disagreeable, can be qualified or covered by pleasant additions. They should be made with materials which, without being wholly insoluble, are dissolved slowly by the saliva. Demulcent medicines are often administered in this form; and it is convenient in all cases, in which the object is to sustain a slight impression steadily on the interior of the mouth and fauces. Sir J. Y. Simpson, of Edinburgh, informed me that he was much in the habit of administering certain medicines, especially to children, in the form of *biscuit*, the powder being incorporated with the dough, and then baked with it. Of course, this method of administration is applicable only to substances not injured by heat.

6. CATAPLASMS, or POULTICES (*cataplasmata*), are intended only for external use. They should be soft and moist, somewhat tenacious, and of such a consistence as to accommodate themselves accurately to the part to which they are applied, without being disposed to spread, or to adhere firmly to the skin. They may be employed solely in reference to the sedative influence of the water they contain, or to protect the diseased surface from the air, or to produce the peculiar impression of a medicine either on the surface, or, through the medium of absorption, upon the system.

7. OINTMENTS (*unguenta*), CERATES (*cerata*), and PLASTERS (*emplastra*) are preparations also intended exclusively for external use. As the terms will be frequently used, the student should have a precise idea of their meaning at the outset. *Ointments* are soft solids, always containing fatty or oily matter, and capable of being applied by gentle rubbing, or, to use an appropriate phrase, by inunction. *Cerates* are of a firmer consistence, generally contain wax (*cera*), from which they derive their name, and are capable of being spread by means of a spatula, at common temperatures, upon suitable dressings, in which state they are usually applied. *Plasters* differ from cerates in possessing a still firmer consistence, requiring heat in order that they may be spread, and, though quite firm and brittle at common temperatures, becoming softish, tenacious, and adhesive at the temperature of the skin. Either of these preparations may be employed exclusively for local effect, or with a view to act upon the system. For the latter purpose, the ointments are preferable

when the cuticle remains; as, by the friction with which their application is often accompanied, they may be forced between the epidermic scales, and thus brought more completely within reach of absorption.

8. Extracts (*extracta*) are rather modes of pharmaceutical preparation, than forms for administration. They consist of the active ingredients of complex medicinal substances, extracted by water, alcohol, or acetic acid, or by expressing the juice of plants, and then evaporating to the solid consistence. Some of them are so dry that they may be readily reduced to powder, and given in this state. All of them may be administered in the form of officinal mixture. But the most common method of exhibition is in the shape of pill, to which they are often very readily brought, in consequence of their soft, somewhat cohesive consistence.

SUBSECTION II.

Liquid Forms.

In the *liquid form* medicines may be given internally, or applied to the surface. In the former case, if taken in any considerable quantity, they receive the name of POTION (*potio*), or DRAUGHT (*haustus*); the former being sometimes applied to a quantity of liquid which may be taken in divided doses, the latter exclusively to a single dose. Applied to the surface, they receive the name of LOTION (*lotio*) when thin and watery, and of LINIMENT (*linimentum*) when of a soft oleaginous consistence, fitted for application by gentle friction with the hand. One of our late officinal liniments (*Linimentum Saponis Camphoratum*, U. S. 1850) was of the consistence of a soft solid when cold, but became quite liquid at the temperature of the body. Some medicines are essentially liquid, as castor oil, glycerin, etc.; others are brought to the liquid form by admixture and suspension, or by solution. The following are forms of officinal liquid preparations.

1. Mixtures (*misturæ*), in the sense of the term as employed in the U. S. Pharmacopœia, are preparations in which a medicine, insoluble in water, is suspended in that fluid, pure or variously medicated, by means of viscid soluble substances, as gum arabic, sugar, and the yolk of eggs.* The term *julep* embraces both these preparations and others in which the mixed substances may be dissolved. The form of mixture is one of the most common and convenient for the administration of insoluble medicines. As a general rule, the medicine is so proportioned in the mixture as to render the dose a tablespoonful (f℥ss) for an adult.

---

* In the U. S. Pharmacopœia of 1860, one preparation was admitted, in derogation of this rule, among the *Mixtures*, that, namely, of *Mistura Potassæ Citratis*, which is strictly, as it was called in the Pharmacopœia of 1850, a solution of citrate of potassa. (*Note to the third edition.*)

2. **Solutions** (*liquores*) are preparations in which the medicine, or its active principle, is dissolved in water or other menstruum. The *officinal Solutions* (Liquores, U. S.), now first adopted as a pharmaceutical class in the U. S. Pharmacopœia, are exclusively aqueous solutions, with one single exception, that of *Liquor Gutta-perchæ*, in which chloroform is the menstruum. In relation to medicines which are wholly soluble, the process is extremely simple; and the only rule requiring attention is not to mix, in the same solution, substances which will undergo mutual decomposition, so as to form an insoluble precipitate. In administering in solution substances, the absorption of which is desirable, it is important that, if irritant in their character, they should be so far diluted as to produce as little irritation as may be of the alimentary canal. Medicines generally find a readier entrance into the system when largely diluted than when concentrated. Under the head of solutions may be considered various officinal preparations, in which the soluble and active principles of a medicine are extracted, leaving behind the insoluble and inert. Such are the *waters*, *infusions*, *decoctions*, *tinctures*, *spirits*, *wines*, *vinegars*, *syrups*, *honeys*, *oxymels*, *fluid extracts*, and *oleoresins* of the pharmacopœias.

3. **Waters** (*aquæ*) are forms of solution which have been long in use, and which, with a somewhat peculiar signification, constitute a class of preparations in our Pharmacopœia. Formerly, the name was somewhat indefinitely applied, embracing certain solutions of solid bodies, as lead-water, lime-water, tar-water, etc., and was occasionally extended in common language to spirituous preparations, as cologne-water, lavender-water, etc.; but, so far as it had a distinctive meaning, it was used to designate watery solutions of volatile substances, obtained by distillation; as *mint-water*, *rose-water*, etc. In the present Pharmacopœia, the title Waters or *Aquæ* is restricted to preparations in which volatile or gaseous substances are held in solution by water, no matter how the solution may be effected, whether by distillation with water, by simple trituration, or other method of impregnation; the condition being essential that the preparation might be made by distillation, as it often was originally. The medicines most frequently thus treated are the volatile oils of aromatics, as of *mint*, *cinnamon*, *fennel*, etc.; but the category also embraces other medicines, as the waters of ammonia, carbonic acid, and chlorine; while solutions of non-volatile substances formerly called waters, as lime-water (*aqua calcis*) and potassa-water (*aqua potassæ*), are now designated as solutions (*liquores*).

4. **Infusions** (*infusa*) are aqueous solutions made by treating with water, without boiling, medicines containing principles soluble in water, with others insoluble. They are either *cold* or *hot*, the former being prepared with water at ordinary temperatures, the latter with the same liquid previously heated to the boiling point. Hot water acts more

rapidly than cold under circumstances otherwise the same, and may, therefore, be preferred when speedy action is desirable. But it is sometimes objectionable in consequence of dissolving starchy matters, which are insoluble in cold water, and the presence of which may render the infusion more liable to speedy change. On the contrary, cold water is liable to the same objection in reference to vegetable albumen, which it dissolves, while hot water coagulates instead of dissolving it. Heat injuriously affects the virtues of certain medicines, and should not, therefore, be employed in preparing them. These considerations should be allowed some weight in the choice between cold and hot infusion. Many of the infusions are most elegantly and efficiently prepared by the process of *percolation* or *displacement*. The U. S. Pharmacopœia uses both the method of percolation and that of simple maceration, preferring one or the other according to the nature of the substance used; and sometimes it presents the alternative of either method in reference to the same substance. Where percolation is used, the plan pursued is to moisten the medicine, in powder, with a little of the menstruum, then to pack it in a percolator, and pour on water till the infusion passed measures a given quantity, which is generally a pint. (See *U. S. Dispensatory.*) In domestic practice the method of maceration should generally be preferred; as that of percolation requires a degree of skill possessed only by the practical pharmaceutist.

5. Decoctions (*decocta*) differ from infusions simply in the circumstance that boiling is used in preparing them. They are liable to the same objections as the hot infusions in a still greater degree, but are convenient when haste is requisite, and the active principles of the medicine are not likely to be materially injured by the heat. As atmospheric air, at a high temperature, is liable to act injuriously on various vegetable principles, the process should be performed in a covered vessel, and should not be continued longer than is necessary to the end in view. Hard, tough, fibrous substances are often most conveniently treated in this way; but the process is altogether inapplicable to those medicines whose activity depends upon a volatile principle, as, for example, upon a volatile oil. In the present Pharmacopœia, a somewhat modified plan of preparing the decoctions has been adopted. The substance treated is boiled with water generally for fifteen minutes; after which the whole is placed upon a strainer, and sufficient water added, through the strainer, to make the decoction measure a certain quantity, which is generally a pint. More precision in the result is thus obtained than by the old method of merely boiling and straining.

6. Tinctures (*tincturæ*) are alcoholic solutions of medicinal principles. As, in consequence of the preservative influence of the alcohol, they may generally be kept, in well-closed bottles, an indefinite length of time, they are almost always prepared by the pharmaceutist, and very seldom extem-

poraneously. In much the larger proportion of them, the process of percolation is employed, somewhat varied according to the nature of the medicine used. It should be remembered that some of them are prepared with officinal alcohol (sp. gr. ·835), and others with diluted alcohol, made by mixing equal measures of the officinal alcohol and water. The former are of course more stimulating than the latter, so far as concerns the menstruum; and this circumstance may be occasionally of practical importance. The officinal tinctures (U. S. Pharmacopœia) of the pure resins, gum-resins, balsams, aconite root, hemp, nux vomica, American hellebore, ginger, castor, and iodine are made with the stronger alcohol; almost all others, including those of the roots, barks, leaves, and fruits of plants, with the diluted. This set of preparations is applicable only when some degree of stimulation is admissible, or when the active principle dissolved in the alcohol is so powerful as to render the amount of the menstruum employed in each dose insignificant, as in the instances of tinctures of aconite root and opium. They are especially useful as adjuvants to other forms of preparation, when it is desirable to render these somewhat more stimulating. Thus, tincture of Peruvian bark may, in low forms of disease, be very appropriately added to the infusion or decoction, or to the solution of sulphate of quinia. In relation to the long-continued employment of tinctures, the practitioner should be aware of the danger of establishing a habit of intemperance, and should be on his guard accordingly. The resinous and camphorous tinctures become turbid on the addition of water, in consequence of the precipitation of the resin or camphor, and should therefore be given with a viscid liquid, as mucilage, syrup, or sometimes milk, or, if diluted with water alone, should be taken immediately after admixture.

7. SPIRITS (*spiritus*) are closely analogous to tinctures, being, like them, solutions of medicinal principles in alcohol, but differing, as formerly understood, in being prepared by distillation. As many of the spirits are now prepared by simply dissolving in alcohol the principles originally separated from the substances containing them by distillation, and as this mode of preparation is recognized in the present U. S. Pharmacopœia, the meaning of the term must be considered as having been officinally extended so as to include all alcoholic solutions of volatile principles, whether made by means of distillation or otherwise. Thus, the term spirit of peppermint, originally applied to the liquid obtained by distilling peppermint with alcohol, is now used to designate the simple alcoholic solution of the volatile oil, which in the previous Pharmacopœia was denominated tincture of oil of peppermint.

8. WINES (*vina*) differ from the tinctures simply in being prepared with wine as the menstruum, instead of alcohol or diluted alcohol. These are also usually the subjects of officinal preparation. The advantages of wine, in the cases to which it is applicable, are that it is less stimulant

than alcohol, while it is more effectual than water in counteracting the tendency of the organic medicinal principles to decomposition, and, in consequence of the alcohol it contains, is sometimes more effective as a solvent. For the purposes of a medicinal solvent, the stronger wines are preferred to the weaker; as the latter are apt to contain principles incompatible with the substance dissolved. Thus, Madeira, sherry, or Teneriffe should be preferred to claret or the Rhine wines. Port wine is seldom proper, on account of the tendency of the tannic acid it contains to form insoluble compounds with other bodies.

9. VINEGARS (*aceta*) are simply infusions made with cold distilled vinegar, or diluted acetic acid. Very few of them are used; and these more in the preparation of other forms of medicine, than for direct administration. Thus, vinegar of squill is much used as an ingredient in the syrup of squill, seldom alone. This class of preparations is based on the fact, that in certain cases acetic acid favours the solvent property of water, while it also has a preservative effect, though in this respect much less efficient than alcohol.

10. SYRUPS (*syrupi*) are aqueous solutions of sugar impregnated with medicinal principles. When the term SYRUP (*syrupus*) is used singly, it implies, officinally, a simple solution of sugar in water, of a certain recognized strength, which, according to the U. S. Pharmacopœia, is about two and a half pounds of sugar to a pint of water. The medicated syrups are designated by the name of their chief medicinal ingredient, as syrup or rhubarb, syrup of ginger, etc. The mode in which the medicinal impregnation is effected varies much with the character of the medicine. The syrups are generally subjects of officinal direction, and are kept ready made in the shops. Their advantages are that the sugar serves to cover the disagreeable taste of the medicine, and at the same time prevents its spontaneous decomposition. They are favourite preparations in infantile cases; but, in their use, the physician should bear in mind the frequently injurious effect of much sugar in a feeble stomach.

11. HONEYS (*mellita*) differ from the syrups only in the substitution of honey for sugar. They are at present little used; honey, in consequence of its impurities, being inferior to sugar as a preservative.

12. OXYMELS are preparations in which the menstruum consists of honey and vinegar combined. They are now almost out of use; oxymel of squill, which for some time was the only one officinal, having been recently discarded by the Pharmacopœias.

13. FLUID EXTRACTS (*extracta fluida*) are highly concentrated solutions of the active constituents of medicines, or the active constituents themselves extracted in the liquid state; and are often very convenient and efficient preparations. They have been introduced into use at a comparatively recent date, and are at present much employed. There are two kinds of them. In one, the active principles of the medicine are

extracted by alcohol or diluted alcohol, sugar is often added as a preservative, and to improve the flavour, and the alcohol is afterwards to a greater or less extent evaporated. These are concentrated alcoholic solutions, or aqueous solutions with a little alcohol remaining. The other kind consist mainly of volatile oil and resinous matter, extracted by ether from the medicine, and subsequently freed from the solvent by evaporation. To the latter division the name of **OLEORESINS** (*oleoresinæ*), expressive of their composition, has been applied in the latest edition of our Pharmacopœia.

14. **GLYCERATES** (*Glyceroles*) are preparations, recently introduced, in which glycerin serves as the menstruum. Advantages of these preparations are that glycerin dissolves substances which water will not, that it does not evaporate spontaneously like water and alcohol, and that it contributes to the preservation of the substance dissolved, without being stimulating or irritating like spirit. Several of the glycerates are more or less used, as those of *iodine*, *aloes*, and *tar*; but they do not as yet form a class in our officinal code.

15. *Spray.* As it is desirable, in certain diseases of the air-passages, to bring various substances into contact with the diseased surface in the liquid form; but, from the great sensitiveness of the respiratory organs, it has been found extremely inconvenient to introduce liquids in an aggregate condition beyond the glottis; the expedient has been adopted of bringing the liquid into a state of extremely minute division, and then causing it to be inhaled admixed in this condition with the atmospheric air. The names of *atomization*, *pulverization*, and *nebulization* have been given to the different processes by which this minute division is effected; and instruments adapted to the purpose are called *atomizers*, *pulverizers*, etc. In treating of the forms in which liquids are used, it was necessary to call attention to this method of applying them; but it will be found more convenient to consider the subject fully in connection with the lungs, as one of the parts to which medicines are applied; and the reader is accordingly referred to the subsection in which inhalation is treated of.

SUBSECTION III.

Aëriform State.

This may be a state either of *gas* or *vapour*. **GASES** are aëriform fluids which retain their condition at common temperatures. **VAPOURS** are likewise aëriform fluids, but require an elevated temperature, under the ordinary degree of atmospheric pressure, to enable them to retain that state, and, upon the diminution of their temperature, become liquid or solid. Both gases and vapours are employed as medicinal agents, the former seldom, the latter very frequently. Gases are used chiefly by inhalation; vapours both in this manner, and by application to the surface of the body.

SECTION III.

Parts to which Medicines are Applied, and Modes of Application.

The parts to which medicines are applied, in order to affect the system, are chiefly 1. the alimentary canal, 2. the skin, 3. the bronchial tubes and pulmonary air-cells, and 4. the subcutaneous areolar tissue. When applied to other surfaces, it is generally with a view to local effect.

SUBSECTION I.

Alimentary Canal.

Medicines are applied to the two opposite extremities of the alimentary canal; to the stomach, namely, and to the rectum.

1. *The Stomach.* This is the most convenient, generally the most effective, and by far the most frequently employed avenue for medicines into the system. To this, as to any other part, they may be applied with the view exclusively to a local effect; but much more frequently the object is to act on the system at large, or on some distant part, for which the stomach affords great facilities, both by the readiness with which absorption takes place from its inner surface, and the sympathies which connect it, beyond any other accessible organ, with all parts of the body. The forms in which medicines are introduced into the stomach have been already referred to. The modes of administering them are in general too obvious to require notice. Two or three remarks, however, upon this point will not be irrelevant. 1. Sometimes patients are comatose, and cannot voluntarily swallow medicines. In these cases, there is sometimes danger of the medicine passing into the glottis, and producing embarrassment of respiration. Substances, however, which act in small doses, as croton oil, may be placed upon the tongue towards its further extremity, where they excite the reflex action of deglutition, and are often swallowed. 2. Children not unfrequently refuse to take medicine into their mouth, and cannot be prevailed on by any persuasion. They can generally be made to swallow, without great difficulty, by taking them in the lap, closing the nostrils so as to compel them to open the mouth, and then introducing the medicine by a teaspoon. 3. In the cases of adults who, from insanity or the purpose of suicide, will not, or from paralysis or insensibility, cannot take medicine, the physician may sometimes be justified, in order to save life, in forcibly injecting it into the stomach by means of the stomach-tube and a syringe.

Attempts have been made, in cases of impervious and incurable stricture of the œsophagus, to prevent starvation by making a fistulous opening from without into the stomach, through which food might be introduced; but the experiment, though not without some encouraging circumstances, has not hitherto proved successful. Considering that, in several instances, such openings have resulted from accidental wounds, and the patient afterwards recovered, with a permanent fistulous orifice, or even an aperture of considerable size, the operation of gastrotomy would seem to be justifiable in otherwise necessarily fatal cases. (See *Guy's Hospital Reports*, iv. 1.)

2. *The Rectum.* Medicines are employed by the rectum with two distinct objects; one to evacuate the bowels by simply irritating the part, the other to produce their peculiar and characteristic impression either on the rectum itself, or, through absorption or sympathy, upon other parts, or the whole system. These two objects are often incompatible; and it is necessary, therefore, when the latter effect is desired, to administer the medicine in such a manner as not to produce the former. But, in either case, the patient should be directed to resist the immediate impulse to evacuate the bowels; as, even when the cathartic effect is aimed at, time should be allowed for the influence of the medicine to be extended to the higher portions of the large intestines, which might otherwise not be affected, and only the rectum emptied. Medicines may be administered by the rectum either in the liquid or solid form. In the former case, they are called *enemata, injections*, or *clysters;* in the latter, *suppositories*.

In either of the forms mentioned, the *dose* of the medicine, when given in reference to its peculiar effects, may be about *three times* that given by the mouth. But, as the relative susceptibility of the stomach and rectum varies, it would be a safer course, when the medicine is very active, as in the instances of the poisonous alkaloids, to administer at first about the same dose as by the stomach, and increase afterwards if necessary. There is another important consideration in regard to the relative dose by the stomach and rectum. When an individual has become habituated to very large quantities of the more active medicines by the mouth, as opium, for example, it might be very dangerous to triple the quantity, when administering it per anum. Though, undoubtedly, the loss of susceptibility is mainly in the nervous centres, it is very probable that the stomach experiences the loss in a greater degree than other organs, and that, applied to another part, the medicine might be found to exercise a much greater proportionate influence. It would be best, therefore, in such cases, not only not to triple the dose, but not to increase it at all, and at first even to administer the medicine in much smaller quantity by the rectum than the stomach, until the relative susceptibility of the two parts, or the relative facility of absorption from them, shall have been tested by trial.*

The circumstances under which medicines may be administered by the rectum, in reference to their peculiar effects, are the following: 1. when the stomach is unable to retain them, or from any cause they may be thought injurious to that organ; 2. when it is desirable to produce a very rapid or powerful impression on the system, and thus to seek an entrance into it by every avenue; 3. when, from the long continuance of the indication for the use of any medicine, it is advisable to vary the surface of application, in order to avoid wearing out the susceptibility of the stomach, and thus to prolong the period during which the effects of the medicine may be sustained; 4. when the seat of disease is in parts neighbouring to the rectum, and the disease itself is of such a character as to be relieved by impressions made in its vicinity more speedily and effectually than through the system at large, as in painful affections of the urinary and genital organs; and 5. when the indication is to produce the effects of the medicine upon the rectum itself, as in neuralgia or spasm of that bowel, and chronic inflammation and ulceration of its lining membrane. Medicines are also exhibited in this way, in order to weaken or destroy the thread-worm which infests the rectum.

Enemata. When intended to evacuate the bowels, the enema should measure for an adult a pint or somewhat less, for a youth of twelve years about half the quantity, for a child one or two years old two fluidounces, and for an infant at birth one fluidounce. Too great a quantity, if used habitually, may injuriously distend the rectum, and diminish its power of contraction. Upon the subject of cathartic enemata more will be said under the head of cathartics.

When the object is to obtain any characteristic effect from medicines, other than purgation, the bulk should be small, say from one to four fluidounces, and the vehicle very bland, consisting of pure water, or of some mucilaginous or starchy fluid; and, when there is danger of its being rejected, from twenty to forty drops of laudanum, or an equivalent quantity of some other liquid preparation of opium, should be added, in order to control the irritability of the rectum.

---

* Experiments performed by Mr. W. S. Savory on the lower animals, especially the rabbit, guinea pig, and rat, show that certain medicines injected into the rectum act much more vigorously, in these animals, than when introduced in the same dose into the stomach. This was true especially of strychnia; but the same results, though in less degree, were obtained with other medicines, as cyanide of potassium and hydrocyanic acid. (*Lancet*, May 9, 1863, p. 516; also *Ibid.* p. 548.) Mr. Savory, however, states that, in order to obtain these results, the medicine must be exhibited in the liquid form; as in the solid state the substance often remains long in the rectum without effect. (*Med. T. and Gaz.*, June, 1865, p. 586.) These results of Mr. Savory confirm the propriety of the caution given in the text. In relation to powerful medicines, administered in the liquid form, it would be prudent never to commence with them by the rectum in larger dose than by the stomach. (*Note to the third edition.*)

The most convenient instrument for the administration of enemata is on the whole a *good metallic syringe*, which may vary in capacity, according to the bulk to be thrown up, from a pint to two fluidounces. The old-fashioned *pipe and bladder* may be resorted to, in the absence of this instrument. The gum-elastic bottle with a tube is still more convenient. Another instrument, sometimes used in France, is a *slender, water-proof, tube-like bag*, three or four feet long, two or three inches in diameter at the larger end, and gradually diminishing to the smaller, to which an ivory pipe is attached for insertion into the rectum. When employed, the pipe is introduced, the larger extremity of the bag held up as high as it will extend, and the liquid poured in. This either enters the rectum by its own specific gravity, or may be gently forced in by running the fingers, pressing the bag between them, from the upper gradually down towards the lower end. The *self-injecting apparatus*, which is a kind of forcing-pump, is very useful when an individual wishes to administer an enema to himself, and also when the object is to throw an indefinite quantity of liquid into the bowels, with the view of overcoming obstruction.* Whatever instrument is employed, the liquid injected, as well as the instrument itself, should be at about the temperature of the interior of the body; and, after the injection, the operator, in cases where there is any disposition to a premature discharge of the liquid, should aid the efforts of the patient to retain it by pressing a warm folded towel against the fundament, until the first irritant effect shall have passed away. Great care should be taken not to wound the mucous membrane by entangling the end of the pipe in its folds, or pressing it against the membrane too strongly. Severe pain is sometimes produced by a neglect of this caution. In relation to the medicine injected, if a soluble substance, it should be dissolved; if a solid, or liquid not soluble in water, it should be thoroughly and equably incorporated with the liquid vehicle by means of some suspending substance. When an irritating substance, such as oil of turpentine, is injected, the yolk of eggs is an excellent intermedium.

---

* The apparatus of Dr. Mattson is very convenient for the same purpose, being exceedingly simple, and easy of application. It consists of a gum-elastic bag, communicating near its orifice with a rectum tube, and having a short tube with a valve opening inward inserted into its orifice, through which the liquid to be injected enters the instrument. The open end of this tube is introduced into the liquid, which is drawn into the instrument, and then forced into the rectum, by the alternate expansion and compression of the bag. (See *Boston Med. and Surg. Journ.*, liii. 274.)

A still more convenient instrument, which is a modification of Dr. Mattson's, is described in the *London Lancet* (March 31, 1866, p. 349). It consists of a stout oval gum-elastic bag, communicating at one end with a rectum tube, and at the other with a water-proof bag containing the liquid to be injected, a valve opening inward being placed at the orifice connected with the receiver. By alternate pressure with the hand, it is obvious that the gum-elastic bag will be alternately emptied into the rectum and filled from the receiver until any desirable quantity of liquid is made to enter the bowel. (*Note to the third edition.*)

Advantage might sometimes ensue, in cases in which a speedy operation of the medicine is essential, and the stomach will not retain it, from introducing it by means of a long flexible tube far up into the colon. Being thus diffused over a greater extent of surface, it might possibly be absorbed more rapidly, and in greater amount, and consequently produce a more speedy and powerful effect.

Suppositories. Like enemata, these may be used simply to evacuate the bowels by irritating the rectum, or to produce the peculiar effect of the medicine employed. For the former purpose, they may be of a cylindrical, oval or conical form, an inch or two in length by about half an inch in diameter, and made of some softish material, like soap or cacao butter. For the latter, they should be as small as is consistent with due effect, and preferably of the pilular form; the object being that they should irritate as little as possible. Opium is not unfrequently employed in this way. Suppositories, with a view to systemic effect, have recently come into more extended use. They have even been adopted as officinal in the British Pharmacopœia. For a fuller account of this set of preparations, see the *U. S. Dispensatory* (12th ed., p. 1361).

Gaseous Injection. Aëriform substances have sometimes been injected into the rectum, though this method of medication is rare. Atmospheric air thrown up largely has been found useful in overcoming obstruction of the bowels; tobacco smoke has been employed to produce relaxation; and carbonic acid gas has been recommended in certain morbid states of the rectum.

Electric action may also be developed in the rectum, either by introducing a complete metallic galvanic arrangement in a compact form, or by passing a wire connected with one pole into the bowel, and applying the other at some point on the back or abdomen.

SUBSECTION II.

The Skin.

Next to the alimentary canal, the skin is most frequently resorted to for the application of medicines. The object may be either to affect the system or some unconnected part through absorption, sympathy, depletion, revulsion, etc., or to act exclusively on the skin itself. The modes of application are various, both in relation to the state of the skin and the substance employed. Thus, the skin may remain undisturbed, the medicine being merely brought into contact with it; or the epidermic scales may be disturbed by friction at the time of application; or the epidermis may be removed, and the medicine placed upon the denuded cutis. The substance employed may be solid, semiliquid, liquid, or aëriform, and, if solid, may be of different degrees of consistence.

1. *Simple Application to the Sound Skin.* Of such application we have examples, with reference to solids, in cataplasms, cerates, and plasters; with reference to liquids, in lotions, fomentations, general baths, local baths, the douche, affusion, and sponging; and, with reference to aëriform substances, in the hot air bath, the general and local vapour bath, and the vapour douche. Of the different solid forms mentioned, as well as of lotions, enough has been already said. *Fomentations* or *stoups* are heated liquids, applied by means of flannels or other cloths saturated with, or wrung out of them. They are usually employed to obtain the effects of water and heat, but sometimes also for the specific effects of medicines, as when the decoction of poppy-heads, or infusion of tobacco is applied.

Baths consist in the direct application of water, either pure or medicinally impregnated, more or less extensively to the surface; the *general bath* being applied to the whole surface, the head perhaps excepted; the *semicupium* or *half-bath*, to the lower half of the body; the *coxæluvium* or *hip-bath*, to the pelvis and upper part of the thighs; the *pediluvium* or *foot-bath*, to the feet and legs; and the *maniluvium* or *hand-bath*, to the hands and forearms.* When the water is made to fall upon the body generally from above, in minute currents or streams, as through a colander, the application is called a *shower bath;* when a single stream of greater or less size is directed upon one part with more or less force, it is named, from the French, the *douche.* In all these, the water may be cold, warm, or hot; and we thus have the *cold bath*, the *warm bath*, and the *hot bath*, which are very different in their effects, and employed for a great diversity of purposes. Of the principles of operation, and of the applications of the different forms of baths, I shall have occasion to treat, at some length, under the different classes of remedies to which they respectively belong. It is sufficient here to state that the bath, when below 75°, may be called a *cold bath;* when between 85° and 98°, a *warm bath;* and from 98° to 112°, a *hot bath.* Some make a distinction between the *tepid* and *warm* baths, the former being of a somewhat lower temperature than the latter.

---

* The means of employing the varieties of local bathing mentioned in the text are well known; but the application of water to other limited parts than those referred to may be indicated, and some ingenuity would be requisite to fashion apparatus suitable for the purpose. The reader may find it useful to consult, upon this subject, a paper on the "*Localization of Baths*," by Dr. Conrad Mayor, contained in the *New York Journal of Medicine* (3d ser., ii. 182).—*Note to the second edition.*

Water may also be applied to the surface more or less extensively by means of wet sheets, or cloths, which may be wrapped around the whole body, so as to obtain in some degree the effect of the general bath, or folded and applied around the waist like a belt, with a view to local effect.

The *douche* acts not only by the temperature of the water, but also by the shock and pressure, consequent upon the force with which the liquid falls. When continued long, or from a considerable height, say ten or twelve feet, it becomes after a time extremely painful, so as to be quite intolerable; and, on this account, has been employed as an instrument of fear or punishment to criminals and maniacs. So far as it acts mechanically, it is primarily excitant, and secondarily depressing.

Liquid in the form of *spray*, or *pulverized* by minute division in a current of air, has been of late used in the mode of a douche, and produces analogous, but milder effects. Independently of the mechanical results of percussion, and the peculiar local effects of the medicine, it is asserted that substances applied to the surface in this way are sometimes absorbed, and act characteristically on the system. Directed to the conjunctiva, they are said to enter the lachrymal passages and even to reach the nostrils. (*Archives Gén.*, Juin, 1866, p. 725.) When the liquid employed is very volatile, an intense degree of cold may be produced by its rapid volatilization, which has recently been applied to important practical purposes, as will be more fully stated hereafter.

Affusion consists in the pouring of water, at various temperatures, from pitchers, buckets, etc., more or less extensively over the body. It differs from the *douche* in being more diffused, and in falling with less force upon the surface. It has been highly recommended in certain febrile and inflammatory diseases, but requires caution in its use, of which more will be said hereafter.

Sponging is a term sufficiently expressive without definition. It may be employed locally or generally, with water, spirit, or other liquid, at different temperatures. It is often extremely useful.

Heated atmospheric air has been employed as a remedial agent, in the form of a *warm* or *hot air bath.* When the object is that the patient shall breathe the heated air, as well as experience its effects externally, it may be most conveniently accomplished by simply placing him naked in a confined apartment, raised by the introduction of hot air to the required temperature, which may vary from 90° to 150°. More frequently the application is made to the external surface alone, while the patient is allowed to breathe air at ordinary temperatures. This may be done by inclosing the body in a cell, box, or closet of suitable dimensions, so arranged that the head shall project through an opening, which is accurately closed around the neck, while the confined air is heated by any convenient plan. An extemporaneous bath of this kind may be prepared, by supporting the bed-coverings, over the patient in bed, upon two or three pairs of crossed half-hoops, so as to form a vacant space around him; and then either introducing heated air, by means of a tube, from some exterior source, or heating that around the patient by hot bricks, bottles filled with hot water, or bags filled with heated salt, oats, or other suitable material.

Medicated hot air baths may be applied, in the same way, by impregnating the air with gaseous bodies, as chlorine and sulphurous acid, or with the vapours of volatile solids, as cinnabar, iodine, etc.

The *vapour bath*, like the hot air bath, may be so employed that the patient shall or shall not breathe the vapour. In the former case, the heating effect upon the body is greater from a certain temperature of the bath than in the latter; for the natural refrigerating effect of the pulmonary exhalation is prevented. The bath is much more frequently employed in reference to the external surface alone. Various modes of obtaining the effects of the vapour bath have been practised. One of the most simple is to make a space around the patient in bed, by elevating the coverings by means of crossed half-hoops, in the manner above mentioned, and tucking them well in at the sides of the bed or mattress, and then to introduce into this space bricks previously heated, immersed in water, and covered with flannel, taking care that they do not touch the body of the patient. The vapour from the heated bricks soon fills the empty space. Another mode of introducing vapour is by means of Jennings' apparatus, which consists of a tin tube, much broader at one extremity than the other, curved so that the smaller end may be inserted into the space around the patient, while the larger end may be supported on a stool without the bed. A lighted spirit lamp is placed within the broad end of the tube. in the side of which an opening is left for the entrance of air. As the spirit burns, a current of heated air, with the aqueous vapour and carbonic acid resulting from the combustion, passes through the tube, and envelopes the body. A different mode of accomplishing the same end, is to seat the patient on a stool or in a chair, placed either over or in a tub or bucket containing hot water, and then, by blankets descending from his shoulders to the floor, to enclose together his body and the whole apparatus. The heat of the water may be increased by introducing into the tub or bucket heated bricks, as they may be required. Caution, however, is requisite not to scald the patient. A case occurred in Philadelphia, under the care of an empiric, in which a child, subjected to a vapour bath of this kind, was scalded to death.

Where convenience permits, a better vapour bath may be arranged, by making a frame of wood-work, and covering this with cloth impervious to vapour, so as to enclose a space within which the patient may conveniently sit upon a stool or chair, while the vapour is introduced into the lower part of the enclosure, by means of a tube proceeding from a kettle of boiling water. The heat of the vapour may vary from 100° to 150°, and has been increased with impunity beyond the latter temperature; but it is better, in this respect, to err on the side of caution.

Medicated vapour baths may be formed by introducing volatile substances into the water evaporated, so that their vapour may rise with that of the water.

The *vapour douche* is a stream of vapour directed with some force upon a particular part of the body.

2. *Application with Friction.* The friction here alluded to is employed not to excite the surface, but, by deranging the epidermic scales, to force an entrance for medicinal substances to the absorbent tissues beneath. It is made by the hand protected by a leather glove, or by means of a piece of flannel, or of coarse linen. Substances applied in this way are most frequently in the unctuous form, as in the case of the mercurial and iodine ointments; but oleaginous, aqueous, and spirituous medicines and solutions are also not unfrequently used. The medicine employed, if insoluble, should be brought to the finest possible state of division. The parts usually selected for the application are those in which the cuticle is most delicate, as the inside of the upper and lower limbs, especially the inner surface of the thighs; but reference should be had to the special object in view; and, when a particular organ or part is to be acted on, or a tumour to be dispersed, it is usually deemed best to apply the medicine as nearly as may be over the seat of disease. In affections of the absorbent glands, the portion of surface from which lymphatics run through the diseased glands should be preferred.

This mode of using medicines is uncertain in its results, and, in consequence of the irritation produced in the skin, is often inconvenient. But it may be resorted to in aid of internal medication, or when from circumstances this cannot be employed; and it is often very efficient in the cure of local affections, as of neuralgic pains, for example, and tumefactions of various kinds.

3. *The Endermic Method of Application.* In this mode of employing medicines, the epidermis is first removed, and the medicine then applied to the denuded surface. It is by far the most efficient external method. Medicines are rapidly absorbed; and produce their effects in some instances as quickly as when taken by the mouth, or even more so. In cases of great irritability or phlogosis of the stomach, and when the patient cannot or will not take medicines by the mouth, it is an invaluable resource. Other indications for its use are afforded by insusceptibility of the stomach, arising from a long-continued or excessive employment of the medicine, by the necessity in urgent cases of introducing medicines by every practicable avenue, and by the existence of serious local affections, which have refused to yield to remedies addressed to the constitution. The last indication is often very agreeably fulfilled by endermic

medication. I have known, for example, vomiting which had resisted all other means, yield to a salt of morphia sprinkled upon a blistered surface in the epigastrium. This method of medication had long been partially employed, as exemplified in the frequent application of mercurial ointment to blistered surfaces; but it was first systematized by Dr. A. Lembert, of France, whose experiments were repeated and extended by Dr. Gerhard, of Philadelphia, by whose essay on the subject the attention of the profession in this country was first extensively called to it, as a useful mode of employing a great number of medicines. (*N. Am. Med. and Surg. Journ.*, ix. 392, A.D. 1830.) Almost all medicines, the dose of which is not very large, or which do not irritate severely, or corrode the surface to which they are applied, may be employed in this way; but it is especially appropriate to the organic alkalies, and to the other more active proximate vegetable principles. Perhaps no medicine acts more efficiently by the endermic plan than the salts of morphia.

The dose of medicines administered in this way may be twice or thrice that given by the mouth. There is less danger here from an over-dose; as what remains of the offending material may be readily removed, should serious consequences be threatened. Sometimes the medicine will be found to act as efficiently as by the stomach in the same dose.

The part best adapted for the application of the medicine, when some local affection does not call for a special direction, is the epigastrium; but any portion of the anterior surface of the body, or the inner surface of the thighs and arms will answer well. A denuded surface for the purpose is most conveniently obtained by means of a blister of cantharides; though, in cases of great urgency, the more rapid action of the stronger solution of ammonia may be resorted to. Upon the average, the blistered surface may be about three or four inches square. It is not necessary to detach the cuticle immediately. The medicine may be first applied over the raised epidermis, which, if cut freely, will come off with the first dressing.

The medicine should be reduced to the state of a very fine powder, and, if irritant, should be diluted with pulverized gum arabic, or other bland substance, and then sprinkled equably over the surface, or applied upon dressings of simple cerate. If so soft that it cannot be powdered, it may be rubbed up with solution of gelatin, glycerin, mucilage, lard, or cerate, and applied upon pledgets of lint; and substances originally liquid may be applied in the same way.

Care should be taken to avoid irritation as far as possible. Active congestion and inflammation, independently of the pain and inconvenience, interfere with the operation of the medicine by offering an impediment to absorption. Sometimes sloughing results from the incautious use of an irritant medicine, and a permanent scar is left. I have known this to follow the application of sulphate of quinia undiluted.

In cases of excessive constitutional action from the medicine, it may sometimes be advantageously followed, after removal, by a counter-agent. Thus, unpleasant symptoms from strychnia or digitalis, might possibly be relieved by morphia applied to the blistered surface; and the effects of morphia are said to have been neutralized by musk.

SUBSECTION III.

The Lungs.

The bronchial mucous membrane, and the surface of the pulmonary air-cells, afford not unfrequently a ready entrance of medicines into the system, in consequence of the great facility of absorption through their delicate tissue. Indeed, some volatile medicines act much more rapidly and powerfully in this way than when taken into the stomach. The effects, for example, of ether and chloroform are familiar to every one. But the practical use of this avenue into the system is very much limited by the inconvenience, and even danger, of administering most medicines in that way. Some, it is true, have proposed to throw fine *medicinal powders* into the lungs by loading with them the respired air; but when the hazard is considered of exciting inflammation by such means in this delicate tissue, it must, I think, be admitted to outweigh any probable advantages. The substances to which this method is especially applicable are gases and vapours. Of these, some have been employed to act locally on the bronchial passages, as chlorine gas, the vapour of tar and iodine, and the fumes of burning rosin in chronic bronchitis, and ethereal vapour, the smoke of stramonium and tobacco, and the gases evolved by the burning of paper impregnated with nitre, in the asthmatic paroxysm. At present, however, attention is much more than formerly directed to constitutional impression; and various volatile substances have been employed for their exhilarating and anæsthetic effect. Aqueous vapour has been long and much employed by inhalation.

Inhalation may be effected in various ways. One of the simplest is to impregnate the air of the apartment in which the patient is confined with the gas or vapour. In this way a steady effect may be sustained, for a great length of time, by proper attention to the degree of impregnation, so as not to oppress the breathing. Even when the patient is not confined to the house during the day, much advantage will often accrue from medicating the air of his sleeping chamber. Chlorine and the vapour of tar may be thus administered; and I have witnessed the happiest effects from the latter remedy, continued for months, in very threatening chronic pulmonary disease. A convenient method, in the case of tar and other liquids but moderately volatilizable, is to employ a common tin apparatus called the *nurse-lamp,* in which a cup, containing the material to be evaporated, is placed in a small water-bath over a spirit lamp.

Another mode, applicable to very volatile liquids, such as ether and chloroform, intended for temporary use, is to place them upon a large sponge, or piece of linen cloth, a handkerchief or towel for example, and apply this, fully charged, over the mouth and nostrils, so that the patient may inhale their vapour along with the atmospheric air. Sometimes the saturated sponge is enclosed in an apparatus, so arranged that all the vapour which escapes from the liquid shall be inhaled, and thus unnecessary loss be prevented, while a due supply of atmospheric air is insured. In the exhibition of the narcotic vapours, it is of the utmost importance, in order to avoid the most serious consequences, to attend strictly to this latter caution. The patient, rendered more or less unconscious by the medicine, is not sensible of the want of air, and does not, therefore, give warning of his danger to the operators, as he would do under other circumstances. There can be little doubt, that death has sometimes resulted from an insufficient supply of atmospheric air, in this method of using anæsthetic agents.

The pure gases, and the vapours of very volatile substances, such as ether, may also be inhaled by means of an air-tight bag, supplied with a mouth-piece and stop-cock, so as to regulate the escape of the confined gas or vapour. The patient is made to breathe into and out of the bag; but it is obvious that, unless there be a large admixture of atmospheric air or oxygen, life could be sustained but a very short time during such a process, which, therefore, should be of short continuance, and always carefully watched.

The vapour of water, pure or impregnated with various volatile matters, may be inhaled by means of an instrument called the *inhaler*. *Mudge's inhaler*, which has been much used for this purpose, consists of a pewter quart mug, with a metallic removable lid, in which is a small opening to admit the air, and another larger one to which a flexible tube with a mouth-piece is affixed. Water, alone or variously impregnated, is introduced into the instrument, which may then be placed in a vessel containing water, heated to whatever point may be necessary sufficiently to volatilize the confined liquid, the vapours of which are inhaled by the patient, along with the air admitted through the small opening. A better apparatus for the same purpose may be made from a *Wolfe's bottle*, with three tubulures at top, into one of which is fitted a flexible tube with a mouth-piece, into a second a glass tube extending from the air without to a point beneath the surface of the liquid in the bottle, and into the third a glass stopper, to be removed when there is occasion to pour liquid into the bottle. It is obvious that, when the patient inspires, the air from without must pass through the liquid, and thus become more thoroughly loaded with the vapour than it would be likely to be in Mudge's inhaler. An *extemporaneous inhaler* may be made, as formerly suggested by Dr. Physick, by fitting a cork into any broad-mouthed common bottle, making three openings through the cork, and supplying these with tubes in the manner mentioned in reference to the Wolfe's bottle, only that the breathing tube may be straight, and, if glass is not at hand, common pipe-stems, or pieces of goose's quill, lengthened sufficiently by insertion into one another, may be substituted. As in the Mudge's inhaler, a proper temperature of the contained liquid may be maintained, if necessary, by setting the bottle in a water-bath. Besides those mentioned, several other inhalers have been invented, and more or less employed, all, however, acting on the principles referred to.*

Finally, certain fumes and vapours may be inhaled through a common smoking pipe, as those of stramonium and camphor for example, the former being set on fire in the bulb, the latter volatilized in the same position by the current of air passing through it. Another mode of effecting the same object is by the smoking of *cigarettes*, made by rolling into the form of small cigars narrow strips of paper, previously impregnated with a solution of the substance the fumes of which are to be inhaled, and then drying them.

Use of liquids in the form of spray. Reference has already been made to a new process by which liquids are brought into contact with the air-passages, mixed, in a state of extremely minute division, with atmospheric air, or aqueous vapour, but still retaining the liquid form. Liquids in this condition are said to be *pulverized, atomized*, or *nebulized;* and the instruments by which the effect is produced are variously named *atomizers, pulverizers*, or *nebulizers;* the first of these terms being preferred by English writers, the second by the French, and the third by the Germans. As this subject has been pretty fully considered in the recently published edition of my Treatise on the Practice of Medicine (6th ed., vol. i. p. 949), it is unnecessary to do more here than to make a few observations, calculated to give the reader a general knowledge of the subject. It is well known that various substances in solution, or otherwise in the liquid state, often have a curative effect when brought into contact with local diseases, whether of the skin, or of accessible mucous surfaces. It has, therefore, been a desideratum to find a method by which these substances might be applied to the air-passages within or beneath the larynx. Attempts have been made to accomplish this object, to a certain extent, by the injection of liquids into the trachea and bronchia, or by penetrating the rima glottidis with moistened sponge at the end of a long handle; but the inconvenience if not danger of these methods is very great, and their success very problematical. But when the idea suggested itself that the end might be safely attained by imitating certain processes of nature, by which liquids in a state of extremely minute division, still holding soluble substances in solution, might be intimately mixed with air, and in this state safely introduced into the air-passages in ordinary respiration, as when we inhale the spray from breakers on the sea-shore; it was an obvious conception, that this process might be artificially imitated, and medicinal liquids in this way be brought into direct contact with the interior of the lungs. Two methods of accomplishing this object suggested themselves to experimenters; one by causing a small stream of the liquid to be forcibly impelled against a solid body, and thus to be broken into minute particles and diffused in the surrounding air; and another, by which a strong current of air should, at the point of issue from a tube, be made to bear upon a slender column of liquid, and to carry this along with it in the form of spray, expanding into a cone with a constantly increasing base till lost in the atmosphere. Instruments were contrived on both of these principles, and have come into extensive use; those, however, based upon the second plan being generally preferred. For an account of the instruments and their mode of use, I must content myself with referring to my Treatise on the Practice, and to the various published monographs on the subject.* There is reason to believe that good may be effected by this method of inhalation, not only by the curative influence exerted in the diseased membrane by the contact of the medicine, but also through its absorption into the circulation, and the exercise on the system at large of its peculiar powers. It has been objected to this mode of medication, so far as concerns its action on the pulmonary air-tubes, that the pulverized liquid never really passes below the glottis; being deposited before it reaches the respiratory passages. This, however, is not exactly true. Abundant proof has been offered that some substances do in fact reach the bronchia, and beneficial therapeutical effects have been obtained; but it is true, nevertheless, that much of the liquid separates before reaching the interior of the larynx, and very little of it is carried to the ultimate ramifications of the bronchia; so that we must be satisfied with less practical result, as regards pulmonary diseases, than may have been anticipated by some in the beginning. By certain modifications of the apparatus, the pulverization may be effected in the cavity of the mouth, and even in the fauces; so that the spray may be brought to bear with its entire intensity, upon the pharynx, the posterior nares, the entrance of the Eustachian tube, and the exterior glottis; and will probably also pass more deeply into the air-passages than when inhaled, as it ordinarily is, from without. The particular medicines adapted to this mode of exhibition, and the strength of the solutions to be atomized, will be more appropriately considered under the heads of the several medicines employed.

---

* Among these may be mentioned *Chisholm's inhaler* (*N. Y. Medical Record*, Jan. 1, 1867, p. 509); *Nelson's inhaler* (*Lancet*, Feb. 11, 1865); *Curtis's inhaler* (*Med. T. and Gaz.*, Dec. 1861, p. 624); and *Thompson's hydro-pneumatic inhaler* (*Lancet*, Jan. 28, 1860), which, however, acts on a different principle. (*Note to the third edition.*)

---

* I would especially call attention to two essays; one by Dr. J. M. Da Costa, of Philadelphia, in the *N. Y. Med. Journ.* (Sept. and Oct. 1866, pp. 401 and 29); the other by Dr. Ephraim Cutter, of Boston, in the *Med. and Surg. Reporter* (July 14 and 21, 1866, pp. 38 and 60). In the *Boston Med. and Surg. Journal* (Dec. 27, 1866, p. 434) a variety of the apparatus has been described, denominated the "hydrostatic atomizer," in which the pressure of a column of water is employed in order to give requisite force to the current of air, instead of pressure by the hand, by a forcing pump, or by steam, which is employed in other instruments.

Besides the remedial advantages above mentioned as resulting from this method of applying medicines, other useful results have been obtained. For disinfecting purposes the atomizer has been found very efficient, diffusing as it does the disinfecting material equably through the air of the apartment, and thus causing it to act on every particle of the offensive or noxious agent. Another effect is the production of extreme cold by the rapid evaporation of volatile liquids, brought into this state of minute division; and the anæsthetic influence of the cold, thus generated upon the surface of the body, has been taken advantage of to a considerable extent by surgeons. More will be said of both of these effects hereafter in this work.

SUBSECTION IV.

The Subcutaneous Areolar Tissue.

Subcutaneous Injection. Hypodermic Method. These names have been given to a plan of medication, first announced, in 1855, by Dr. Alexander Wood, of Edinburgh, consisting of the injection of remedial substances into the subcutaneous areolar or cellular tissue. Though apparently aware that medicines might be employed in this way with a view to their effects on the system at large, Dr. Wood confined his views practically to their local influence, and especially to the relief of neuralgic pains by anodynes injected into the areolar tissue, as near as possible to the seat of the affection. He no doubt believed that the relief obtained depended on the local action of the medicine. To Mr. Charles Hunter is due the credit of having generalized this plan of medication. He soon satisfied himself that the anodyne effect was obtained by injecting the medicine at a distance from the seat of pain, as well as in its immediate vicinity; and hence concluded that the medicine operated, not immediately on the painful nerve, but through the medium of the circulation, being absorbed into the blood, and carried with it to all parts of the system. He ascertained, moreover, that substances, employed in this way, exercised their ordinary remedial influence over systemic diseases; and the important fact was thus established, that the areolar tissue might be resorted to as an avenue for the introduction of medicines into the system, in all cases in which their relations with this tissue allowed them to be applied to it in a condition permitting their absorption in sufficient quantity, without injurious local effects. It must, nevertheless, be admitted that certain medicines, especially anodynes, such as morphia and aconitia, while they operate on the system generally through absorption, do exercise a peculiar influence in the neighbourhood of their application. This was proved by experiments of Dr. Eulenberg, who found that the sensibility of the parts into which morphia was injected, on one side of the body, was much more diminished than that of the corresponding parts on the other side. (*Am. Journ. of Med. Sci.*, April, 1866, p. 432.) It would probably be a good practical rule, to inject the areolar tissue as near as possible to the seat of the disease, whenever there is good reason to believe that this is exclusively local, and in the arm or any other convenient spot, without reference to the precise locality of the pain, when this depends on disorder of the nerve-centres, a morbid state of the blood, or some other systemic derangement.

After the discovery of the method of subcutaneous injection by Dr. Wood, it came rapidly into use, and is now almost universally resorted to under favouring circumstances. From the abundance of the capillaries distributed i[illegible]areolar tissue, it affords extraordinary facilities for absorption; a[illegible]table remedies, applied in this way, act much more rapidly, a[illegible]nsequently with greater energy in equal quantities, than the sa[illegible]emedies introduced into the stomach or rectum, or employed ende[illegible]ically. One cause, no doubt, of the greater rapidity of the action hypodermically, is that substances taken up from the alimentary canal are for the most part conveyed through the portal veins into the liver, and are distributed through that organ before reaching the general circulation, while from the areolar tissue they probably enter immediately into the veins. Another advantage possessed by this method is that the medicine enters the circulation unchanged, and there exercises purely its legitimate effects on the system; while, when given by the stomach, it is liable to be modified by the action of the various and often powerful agents it finds in the alimentary passages; and, besides, the effects it produces directly on the stomach and bowels, which are often much disordered by it, complicate its proper systemic influences. Mr. Hunter states that the remedial effects of medicines, hypodermically administered, are often more permanent than those from the ordinary methods of exhibition. Thus, he has repeatedly effectually cured cases of disease, by injecting certain medicines into the areolar tissue, which had long resisted the same medicines given by the stomach; being relieved, indeed, for a time by the latter method, but returning constantly with unimpaired force. It has been asserted that narcotics, especially opiates, are less apt to disturb the brain, than when given by the mouth.

Notwithstanding these various advantages of the hypodermic method, the number of remedies to which it is applicable is limited. Many are altogether unsuited to it on account of the large quantity required to operate; others from their insolubility; and others, again, from their irritant properties, which at the same time occasion local inflammation, and interfere with absorption. It is now well known that crystalline bodies in solution are diffused through animal membrane much more readily than gelatinous or glue-like substances (the colloids of Graham), which pass with great difficulty if at all. Hence it may be inferred that active principles of medicines, capable of assuming crystalline forms, are much better adapted than others not crystallizable, to this mode of administration, as likely to find easier admission into the capillaries; and the fact is, that the vegetable alkaloids, as morphia, atropia, quinia, etc., are peculiarly fitted for subcutaneous injection.

The following circumstances are peculiarly favourable to this method of medication. It is called for in cases of great severity, where the prompt relief of pain is required, or immediate interference may be necessary to save life; and, under these circumstances, it may either be depended on as the chief agency, or may be used as auxiliary to the ordinary measures. As examples, may be adduced the excruciating pain attendant on the passage of a urinary calculus, and a case of pernicious fever in which life may depend on the prompt and efficient action of quinia. When the stomach rejects all suitable remedies, or the patient obstinately refuses or is unable to swallow them, subcutaneous injection is a most valuable resource. When, moreover, remedies by the mouth and rectum have been used without satisfactory results, there is a strong indication for this method. Indeed, it may be resorted to in almost all instances, otherwise not unsuitable, in which it may be preferred by the patient.

There are, however, circumstances which considerably limit its applicability. The danger of producing great local irritation, inflammation, or gangrene, is extremely slight, when due attention is paid to the choice of medicines, the proper introduction of them, and the state of the system. Non-irritant remedies, in a liquid form, may almost always be injected without the least inconvenience; or, if a slight irritation be produced, it subsides rapidly, without leaving any unpleasant effect. But substances in themselves irritant, or rendered so by their solid state interfering with absorption, may excite inflammation, ending in suppuration, or perhaps in gangrene, and should, therefore, never be employed in this way, in reference to their systemic influence. Besides, when the system happens to be in a state threatening erysipelas or gangrene; or when these conditions either exist, or a tendency to them prevails in any locality, the hypodermic method should be avoided, or used only under the most urgent circumstances, from the risk that would be incurred of exciting these affections.

In some rare instances, great alarm has been caused by the unexpectedly rapid and apparently dangerous action of medicines injected into the areolar tissue. Thus, morphia has sometimes operated, in the ordinary dose, with extreme violence, so as to threaten life itself, though I have not found recorded any absolutely fatal case from this, or any other medicine used in the same way. This occasional violence is ascribed, and probably with justice, to the penetration of a minute vein, and the consequent injection of the whole dose at once into the current of the circulation. Caution should, therefore, always be observed to avoid any visible blood-vessel; and, when the effect of the medicine is experienced immediately, the instrument should be at once withdrawn. It has been advised, in reference to this danger, to inject the medicine rather slowly, so that the process may be arrested, on the occurrence of violent symptoms, before the whole dose has been injected. In all instances, extreme caution should be observed not to administer excessive doses of poisonous medicines in this way; the danger being greater than when the medicine is swallowed, or given by enema; as, in either of these cases, it may be evacuated, while no such opportunity would be offered in the hypodermic method. Should alarming phenomena, however, result at any time from too rapid or copious absorption from the areolar tissue, a vacuum should be immediately produced, by the application of a cupping-glass over the puncture, so as to impede or prevent the continuance of the process. In the treatment of systemic diseases, it is often desirable to maintain an equable and steady impression by means of medicine. In this case, the exhibition of the remedy by the mouth would be preferable; as absorption is maintained continuously from the stomach; while, given by subcutaneous injection, the medicine acts more or less interruptedly, or by starts.

Operation. When circumstances do not indicate a special site for the operation, the arm near the insertion of the deltoid is perhaps as convenient a locality as can be chosen. When the operation is to be repeated, the place of puncture should be varied, so as to avoid irritating or inflaming the part. The pain from the operation is very slight, not exceeding that of the prick of a pin, and by the most sensitive soon in general comes to be disregarded. Sometimes it may for a time be very acute in consequence of the perforation of a cutaneous nerve; but this rarely happens.

The instrument recommended by Mr. Hunter is a small syringe, with a glass barrel and silver fittings, the piston of which is worked by means of a screw, each half turn of which expels half a minim. The pipe, which is attached by a screw, is of silver, with a hardened gold point, as sharp as a needle, and an opening on one side, near the point, through which the liquid is expelled. No incision or perforation is required, other than that made by the sharp point of the pipe, which is not more painful than the prick of a pin. The liquid to be injected having been introduced into the instrument, the skin is made tense, and the point inserted by a quick movement perpendicularly through the skin, after which any direction may be given to it that may be deemed desirable. Then the required number of minims is injected by as many turns of the screw; so that the dose may be regulated with the utmost exactness. After this the instrument is withdrawn, and, to prevent the escape of the liquid, the perforation is covered with a small piece of adhesive plaster, previously warmed for the purpose.

Different forms of the instrument have been recommended, all having in common the sharp perforated point. In one form, instead of measuring the amount of injected liquid by the turns of a screw, the piston is constructed in the ordinary manner, and the dose measured by a graduation of the barrel of the syringe, or of the piston itself. Instead of the hardened gold point, this is sometimes made of steel, and may be permanently affixed to the instrument, or attached by a screw, and removable at pleasure.

It is important that the point should not become blunted by oxidation or other cause; as the success of the operation, and the avoidance of subsequent injury, depends much on the perfect cleanness and sharpness of this part of the instrument. The syringe, too, should be thoroughly cleansed after each operation, especially when a different medicine is to be injected. A second dose should not be given until the effects of the first have subsided; or, if previously to this time, it should be reduced. Mr. Hunter thinks it advisable, as a general rule, to use a strong solution, so that the required dose may be thrown in by three or four turns of the piston. The quantity thrown in at once should never exceed thirty minims, and less than this will sometimes cause uneasiness by distension, and partially escape through the aperture. The whole process need not consume more than half a minute. It is very important to attend carefully to the operation; as, when the solution is very strong, a few turns of the screw, in excess, may produce serious results. Mr. Hunter recommends that not more than half the full ordinary dose of a narcotic medicine for a man, nor more than a third of it for a woman, should be injected at first; as the medicine operates rapidly, and with the entire force of the quantity introduced, the whole being absorbed.

The medicines given in this way should always be perfectly dissolved; and if, as sometimes happens in using the alkaloids, some acid is necessary for their complete solution, not more should be employed for the purpose than is absolutely required. If the solution is turbid, it should be filtered before being injected. Pure water is the best solvent, though tinctures may be used when deemed advisable. It is especially important that the tinctures should be freshly filtered, as, after long standing, they are apt to deposit a portion of their contents; and this is especially the case with laudanum. In the selection of medicines to be injected, it is desirable to avoid such as give precipitates with the alkaline chlorides and albumen, both of which they might encounter in the areolar tissue.

A use of the hypodermic method not yet referred to, has been suggested and put in practice by Dr. Eulenberg; namely, to facilitate laryngoscopy by the use in this way of morphia, or other medicine calculated to obtund the sensitiveness of the fauces. (*Am. Journ. of Med. Sci.*, April, 1866, p. 436.)

Still another application of subcutaneous injection has been brought to the notice of the profession by Dr. Luton, of Rheims, in France, under the name of *parenchymatous substitution*. He refers to the subcutaneous injection of irritating substances, with the view of exciting more or less irritation, which, according to the substances injected, may be of three grades; *first*, simple pain with insignificant local disorder, *secondly*, an irritative congestion, or, *thirdly*, inflammation with suppuration, etc. The remedial influence aimed at is the substitution of the new excitation for a pre-existing disease of the same part; a principle of therapeutical action identical with that already considered in this work under the name of supersession. (See page 51.) By the first degree of irritation he supersedes neuralgia and other painful affections; by the second, glandular diseases, acute or chronic, and especially strumous engorgements; and by the third, white swellings, local osteitis or periostitis, caries, etc. He obtains these gradations of effect by the injection of substances of various degrees of irritating power, from solution of chloride of sodium, alcohol, etc., which occasion rather severe pain, followed by local swelling, in general readily dissipated, through tincture of iodine, which causes non-suppurative inflammation, sometimes followed by atrophic absorption, to solution of nitrate of silver, sulphate of copper, etc., which give rise to phlegmons with suppuration. (*Arch. Gén.*, Oct. 1863, p. 285.) It is perceived that this application of subcutaneous injection is wholly different from those of Dr. Wood and Mr. Hunter, the former of which aimed at the relief of pain by the local action of anodynes, the latter to the production of remedial impressions through the circulation. It is yet comparatively new, and the recorded experience is insufficient to justify, on that basis, a positive decision as to its merits.

In relation to the particular substances employed in hypodermic medication, their therapeutic application, and the precise dose and mode of exhibition, the reader is referred to the several medicines as treated of in the second part of this work.

SUBSECTION V.

Other Surfaces of Application.

There is no surface attainable from without, to which medicinal applications have not been made, with reference to a curative influence on the surface itself. The conjunctiva, the nasal duct, the nostrils and various cavities communicating with them, the mouth and fauces, the pharynx and œsophagus, the internal auditory meatus, the Eustachian tube, the urethra and bladder, the vagina and uterus, have all been the seats of such applications. Particular names have been given to certain medicines thus employed. Liquid applications to the eye are called *collyria* or *eye-waters;* substances applied to the nostrils, *errhines* and *sternutatories;* liquids to the fauces, *gargarismata, collutorea,* or *gargles;* solid bodies intended to be chewed, *masticatories;* and those applied to the urino-genital passages, if liquids, simply *injections,* if solids, and introduced into the vagina, *pessaries.*

Of all these surfaces, *those of the nostrils* and *mouth* are the only ones to which medicines are habitually applied in reference to any other than a local effect. In consequence of the strong sympathies of the nasal passages with the brain, errhines and sternutatories are not unfrequently employed to rouse the nervous centres, and sometimes also to agitate the respiratory organs by the act of sneezing. Both to the Schneiderian and buccal mucous membrane, medicines are occasionally applied with a view to their revulsive impression, and to the latter sometimes in order to affect the system, as for example by rubbing the medicine upon the gums. It must be confessed, however, that this latter method cannot be looked on as peculiarly efficient; and it is probable that, when any considerable effect has been experienced, it has been the result rather of the portion of the medicine swallowed, than of that absorbed from the mucous membrane of the mouth. There is reason, nevertheless, to believe that medicines are actually absorbed from this membrane, particularly from the surface of the tongue; and substances applied to this organ, and held there for some time, are asserted to have exercised the same remedial influence as when swallowed, without unpleasant effect upon the stomach.

Even to the serous membranes, applications are sometimes made with a view to some alterative effect on these tissues. Thus, injections are thrown into the tunica vaginalis for the cure of hydrocele; and attempts have been successfully made, in a few instances, to cure dropsy by stimulant liquids thrown into the cavities of the pleura and peritoneum; but this practice is too hazardous for general adoption.

Blood-vessels. Many medicines, when injected into the veins, produce the same effects as when taken into the stomach, but generally operate more powerfully. Hence it was long since proposed to administer medicines in this way; and the method has been frequently tried. In some instances it has appeared to do good; but the general experience of its results has by no means been such as to counterbalance its obvious disadvantages; and it is only under the most urgent circumstances, and in cases otherwise desperate, that it would, in my estimation, be justifiable.

When medicines are absorbed into the circulation, they frequently undergo preliminary changes, which probably better adapt them for admixture with the blood. Being taken up gradually, they enter the circulation in extremely minute quantities at one time, so that the whole blood becomes equably impregnated, and the least possible shock is produced either on the circulating fluid, the vessels, or the system. When injected into the veins, it is impossible to introduce them thus gradually and cautiously, and, if the attempt were made, the time consumed would greatly aggravate the danger of the operation. The blood, therefore, at the point of injection becomes too strongly impregnated, and must produce on the tissues more than the desired effect; while it is scarcely possible to calculate what injurious influence may be exercised on its own qualities or constitution. We are too little acquainted with the chemical and vital reactions which take place, under such circumstances, to be able to infer *à priori* what results would ensue; and experiments have not yet been sufficiently numerous and varied to supply this deficiency. The most violent effects have sometimes been produced by substances which, in other modes of application, are quite bland and innocuous. Besides, there are the dangers of injecting air into the veins along with the medicine, and of giving rise to phlebitis by injury of the vein.

Inoculation has recently been proposed as another and safer method of introducing medicines into the blood-vessels; but I cannot conceive of any advantage it possesses over the endermic method, while it is liable to the great disadvantage that the medicine, to produce any effect on the system, must enter the blood in a highly concentrated state, and thus endanger too strong a local impression. An account of Langenbeck's method of applying medicines by inoculation is contained in the *British and Foreign Medico-chirurgical Review* for January, 1857 (Am. ed., p. 203).

Attention has recently been called by Sir J. Y. Simpson, of Edinburgh, to the use of *medicated pessaries*, from which he has found advantage in the production of specific impressions on the uterus and vagina. The medicine is incorporated with some soft solid; and, as in the case of suppositories, cacao butter is admirably well adapted to the purpose. Opiates, astringents both vegetable and mineral, and various other medicines may be employed in this way. (*Edin. Med. Journ.*, May, 1865, p. 1042.)

CHAPTER IV.

Classification of Medicines.

THE use of classification is to facilitate the work both of the author or teacher, and of the student. To the former it is highly advantageous by affording him the opportunity of presenting, in one view, and in a comparatively few words, all the common properties and uses of any number of bodies; so that, in the subsequent description of these bodies severally, he may omit whatever is not peculiar to each, and thus spare himself a vast amount of repetition. To the latter it is almost essential; as, by fixing in his mind the properties of classes, and thus serving to recall these properties in relation to any individual, upon the recollection simply that it belongs to the class, it aids his memory beyond all other contrivance, and enables him to gather and retain an amount of knowledge, which would be quite unattainable were he to study each object in an isolated state. The only kind of works in which classification is unnecessary are those intended, not for continuous study, but for occasional reference, when information is desired upon some particular name or object, such as dictionaries, encyclopedias, and, to a certain extent, dispensatories, in all of which an alphabetical arrangement is most convenient.

The advantages and even necessity of classification being admitted, the next point for consideration is the plan to be adopted. Now it may be asserted, without fear of contradiction, that no plan is faultless. Every mode of classification which has been proposed in relation to remedies has its disadvantages; and it is, therefore, no valid objection to any particular one which may be suggested that it is not perfect. That one, it appears to me, is the best, which best promotes the great object of all classification; the facilitating, namely, of the acquisition of knowledge. As different kinds of knowledge are required of the same bodies by different sets of students, it follows that the classification should be different also; for, to be productive of the most good, it must be based upon the relation of the bodies to one another in those properties which are the special object of study. Thus, in reference to medicines, the intention may be to study them as objects either of natural history, pharmaceutical management, or therapeutic use; and they should be arranged accordingly. Their classification, therefore, should be based, for the general student, upon their geological, botanical, or mineralogical relations; for the pharmaceutist, either upon their chemical properties, or their resemblance in modes of preparation; for the therapeutist, undoubtedly upon their effects on the system, through which they become applicable to the cure of disease. It is in the last-mentioned capacity that they are important to the physician; and in this especially he should be taught, from the earliest period of his studies, to regard them. As, therefore, the present work is devoted more especially to the therapeutic consideration of medicines, I have, without hesitation, adopted a system of classification, founded upon their relations to one another in their modes of affecting the human system.

The question now occurs, admitting the effects of medicines to afford the true basis of classification, whether it is their physiological or therapeutical effects to which we should have recourse. At the first glance it might be supposed that the latter should be preferred. But a little consideration will decide against them. Formerly, when the notion prevailed that there were specific remedies for particular diseases, or classes of disease, an arrangement of medicines based on this principle was to a certain extent naturally adopted. Hence the terms antiphlogistics, febrifuges, antispasmodics, antiscorbutics, antisyphilitics, antilithics, etc. But the fact is, that there is no specific, strictly speaking; that is, there is no remedy which is especially adapted to one disease, and one only, and no curable disease which will yield only to one remedy; and, in relation to classes of disease, such as inflammations, fevers, and spasmodic affections, there is no one which does not require, in different stages, and under different circumstances, the same medicines found useful in the others; so that classes founded on this basis would be constantly clashing, each containing the individuals embraced by the others; and thus all the advantages of classification would be lost. For example, in the treatment of the three sets of diseases above mentioned, in one or another of their stages or varieties, we employ bleeding, cathartics, emetics, narcotics, tonics, stimulants, revulsives, etc. The physiological effects must, therefore, be resorted to; and, happily, it will be found that, to one well acquainted with pathology, these very effects, and consequently the medicines producing them, are suggested by the therapeutic indications. It will be perceived that, in the following plan, all the old classes founded on the therapeutic basis, as antispasmodics and antilithics, have been abandoned, and, except in the instances of the last five or six, which do not act on the system itself, but on extraneous matters accidentally contained within it, and operating as causes of disease, all the classes have a purely physiological relation. I wish it to be specially noticed that, in distributing remedies in the following classes, I am fully aware that the members of one class often possess properties which characterize another; and that, in deciding in which to place them, I have been in many instances influenced by their practical use, giving them a position in accordance with those properties which, if not always most striking, are those which constitute their chief value as medicines, or at least for which they are most employed.

Plan of Classification.

Remedies are divided primarily into those which operate upon the system, and those upon extraneous bodies accidentally contained within the system. The former division embraces the great body of remedies; the latter includes only five or six classes, which are retained for the sake of practical convenience; as it is desirable that the physician should have the substances belonging to them associated together in his memory.

I. SYSTEMIC REMEDIES.

Some remedies extend their action throughout the whole living system; others, operating upon one or more of those functions, as the circulatory and nervous, which pervade the body, are apparently felt in all parts of it, though not strictly universal in their direct influence. All these may be denominated *general remedies.* Another large division act specially on some one part or organ, or, if they affect the general system, do so only indirectly or secondarily. These may be called *local remedies;* and thus we have the basis of the first subdivision.

I. GENERAL REMEDIES.

The general remedies are necessarily, as before stated, either *stimulant, sedative,* or *alterative;* that is, either elevate, depress, or alter the systemic actions. These three sets constitute the second subdivision.

1. General Stimulants.

If the operation of stimulant substances be closely observed, it will be noticed that, while some are slow, moderate, and lasting, others are, on the contrary, quick, energetic, and proportionably brief in their action; though the two sets run together by almost insensible gradations. This difference of operation was made by Dr. Murray, of Edinburgh, the basis of a division of the general stimulants into two distinct sets, which he named respectively *permanent* and *diffusible stimulants.* Though these terms are neither of them very accurately expressive of the distinctive characters of the two divisions, yet it may not be easy to find better, and it is advisable not to adopt new names unless upon some real ground of preference. I have, therefore, admitted this division with the nomenclature.

1. *Permanent Stimulants.*

There is a very striking distinction between the permanent stimulants; one section confining their direct influence to the vital function of organic contractility, the other operating upon the vital functions generally. The first division is very appropriately denominated *astringents*, the second less appropriately *tonics*. They constitute two of the ultimate classes of remedies.

1. ASTRINGENTS are medicines which produce contraction of the living tissues.

2. TONICS are characterized by their general stimulating influence over the functions, operating slowly, moderately, and somewhat durably, either directly through the circulation, or secondarily through the digestive function.

2. *Diffusible Stimulants.*

Some of these appear to be universal, such as heat and electricity; but the greater portion, and perhaps all which come strictly under the denomination of medicines, exhibit a special tendency to one or the other of the two great pervading systems or apparatuses of the body, the circulatory, namely, and the nervous. As those which have a tendency to the circulation operate directly rather upon the arterial than the venous side of it, I name them *arterial stimulants*. Those acting specially on the nervous system may be called *cerebro-spinal stimulants*.

1. ARTERIAL STIMULANTS are scarcely susceptible of further profitable subdivision, and therefore constitute one of the ultimate classes. They are characterized especially by their property of increasing the action of the heart and arteries, and, along with this effect, and probably consequent upon it, of causing an elevation of the animal temperature.

2. CEREBRO-SPINAL STIMULANTS. I do not wish, by the use of this term, to intimate that the remedies so called act exclusively on the brain and spinal marrow; they may possibly, and probably do, in some instances, affect the ganglionic system, and, indeed, the whole nervous substance wherever they may meet with it. There is a marked difference between the members of this subdivision. Whilst some appear to operate equably upon the whole nervous system, showing no special influence over the proper cerebral functions, others act with great energy on the brain, as evinced by their power of deranging sensation, voluntary motion, consciousness, and the various intellectual and emotional functions. The former I denominate *nervous stimulants*, the latter *cerebral stimulants*. Besides these two sets of cerebro-spinal stimulants, there is at least one medicine which acts especially and power-

fully on the spinal marrow, and for which a distinct class may be formed under the name of *spinal stimulants.* These three are all ultimate classes.

a. *Nervous Stimulants,* characterized by a special but equable influence over the nervous system, generally stimulate in some degree, though not necessarily, the circulation also. They are sometimes called *nervines,* and not unfrequently *antispasmodics.*

b. *Cerebral Stimulants,* with more or less influence on the circulation, and sometimes a powerful influence, are peculiarly characterized by their control over the special cerebral functions. They are equivalent to the *stimulant narcotics* of other writers, and embrace some of the most energetic articles of the materia medica, such as alcohol and opium.

c. *Spinal Stimulants* act specially, so far as their operation is known, on the reflex motor function.

2. General Sedatives.

These are remedies which directly depress the vital functions. While a few operate universally, as cold and water, most of them, like the corresponding stimulants, act especially or exclusively on one of the two great systems, the circulatory, namely, and the nervous; some prominently affecting the former, and therefore denominated *arterial sedatives,* others the latter, and named *cerebro-nervous sedatives.*

1. ARTERIAL SEDATIVES constitute one of the ultimate classes. They act mainly, if not exclusively, in their primary influence, upon the heart and arteries, without any direct effect on the cerebro-spinal functions. As, among the results of the circulatory depression, is a reduction also of the temperature, they are frequently called *refrigerants.*

2. CEREBRO-SPINAL SEDATIVES. These may be advantageously divided, like the corresponding subdivision of stimulants, into the *nervous, cerebral,* and *spinal,* which form ultimate classes.

a. *Nervous Sedatives* are such as reduce generally the nervous functions, without any special reference to the brain. They uniformly, either by a conjoint primary action, or secondarily through their influence on the nerves, reduce the force of the circulation also. They are usually designated as *sedative narcotics.*

b. *Cerebral Sedatives* are remedies which, while they depress the circulation either primarily or secondarily, exert a special and marked influence, of a sedative character, on the cerebral functions. Like the preceding class, they would rank with the medicines usually known as sedative narcotics.

c. *Spinal Sedatives* act by directly depressing the special functions of the spinal marrow, including of course its reflex action, with little if any direct influence on the brain.

3. General Alteratives.

These are remedies which insensibly change the functions or organization, without any necessary elevation or depression of the vital actions, and the influence of which is mainly recognized by their effects in disease. They may be stimulant or sedative, and they may produce various local effects which would rank them in other classes; but it is not through these that the special curative effects are produced, which entitle them to the name by which they are distinguished. Knowing so little of their mode of action, we are not possessed of grounds for subdividing them, and they therefore rank with the ultimate classes.

II. LOCAL REMEDIES.

I do not include in this division, in reference at least to their peculiar and characteristic properties, the general remedies which may sometimes be made to act locally by confining them to a particular part; as opium, for example, and belladonna, both of which are sometimes applied to the surface, with the view of affecting exclusively the neighbourhood of their application. The division includes only remedies which either have a special direction to some particular organ or part of the body, to whatever portion of it they may be applied, or which, if possessed of general powers, are employed locally for some effect different from the general; as when potassa, for instance, is used as an escharotic, cantharides for blistering, and mustard as a rubefacient, which effects are not incident to their internal use as medicines.

With a few exceptions, all the local remedies are more or less stimulant; and the possession, therefore, of this property, or that of depression, does not constitute a sufficient ground of distinction between them. Consequently, some other basis of classification must be sought for; and it has appeared to me that they might be most conveniently arranged according as they are employed to affect the functions, or to change the organization, or to act merely as mechanical agents.

1. Local Remedies acting on the Functions.

The subdivisions of these are all ultimate classes of medicines and are as follows:

1. EMETICS, which operate on the stomach, producing vomiting;
2. CATHARTICS, which operate on the bowels, producing their evacuation downward;
3. DIURETICS, which act on the kidneys, increasing the secretion of urine;
4. DIAPHORETICS, which act on the skin, causing perspiration;

5. EXPECTORANTS, which act on the lungs, causing expectoration;

6. CHOLAGOGUES, which act on the liver, increasing the secretion of bile;

7. EMMENAGOGUES, which act on the uterus, exciting, increasing, or restoring the menses;

8. UTERINE MOTOR-STIMULANTS, which favour uterine contraction;

9. SIALAGOGUES, which increase the secretion of saliva; and

10. ERRHINES or STERNUTATORIES, which operate on the nostrils, causing an increased secretion, and sneezing.

2. Local Remedies affecting the Organization.

The subdivisions of these are also ultimate classes, and are as follows:

1. RUBEFACIENTS, inflaming the skin;
2. EPISPASTICS, producing blisters; and
3. ESCHAROTICS, destroying the life of the part, and producing a slough.

3. Local Remedies acting Mechanically.

These include, besides the various measures enumerated under the head of "Mechanical Influence" (*page* 53), the following classes of medicines:

1. DEMULCENTS, bland viscid liquids, which cover surfaces and protect them from irritation, or mingled with acrid substances obtund their acrimony;
2. EMOLLIENTS, which soften and relax;
3. DILUENTS, which dilute the fluids of the body; and
4. PROTECTIVES, which operate by covering the surface, and preventing the contact of the air.

II. NON-SYSTEMIC REMEDIES.

These are remedies acting on bodies foreign to the system, but within it. They embrace the five classes of

1. ANTACIDS, which neutralize acid in the stomach, or elsewhere in the system;
2. ABSORBENTS, which, by absorbing acrid or irritating matters, prevent or diminish their irritant action;
3. SOLVENTS, which effect the solution in the stomach of substances otherwise insoluble;
4. DISINFECTANTS, which chemically destroy noxious and fetid exhalations; and
5. PARASITICIDES, which are destructive to the lower forms of animal and vegetable existence, seated in the human body, and acting injuriously upon it. These include the two subclasses of

a. *Anthelmintics*, which favour the expulsion of worms from the bowels; and

b. *Antizymotics*, which are destructive of those microscopic organisms which support fermentation, and thus probably cause and sustain the proper zymotic diseases.

The following is a tabular view of the foregoing classification; the ultimate classes being in italics.

- SYSTEMIC REMEDIES.
  - General remedies.
    - Stimulants.
      - Permanent stimulants.
        - *Astringents.*
        - *Tonics.*
      - Diffusible stimulants.
        - *Arterial stimulants.*
        - Cerebro-nervous stimulants.
          - *Nervous stimulants.*
          - *Cerebral stimulants.*
          - *Spinal stimulants.*
    - Sedatives.
      - *Arterial sedatives.*
      - Cerebro-nervous sedatives.
        - *Nervous sedatives.*
        - *Cerebral sedatives.*
        - *Spinal sedatives.*
    - Alteratives.
  - Local remedies.
    - Affecting the functions.
      - *Emetics.*
      - *Cathartics.*
      - *Diuretics.*
      - *Diaphoretics.*
      - *Expectorants.*
      - *Cholagogues.*
      - *Emmenagogues.*
      - *Uterine motor-stimulants.*
      - *Sialagogues.*
      - *Errhines.*
    - Affecting the organization.
      - *Rubefacients.*
      - *Epispastics.*
      - *Escharotics.*
    - Operating mechanically.
      - *Demulcents.*

- *Emollients.*
- *Diluents.*
- *Protectives.*

NON-SYSTEMIC REMEDIES.

- *Antacids.*
- *Absorbents.*
- *Solvents.*
- *Disinfectants.*
- *Parasiticides.*
  - Anthelmintics.
  - Antizymotics.

The plan of arrangement here presented does not claim to be perfect. It is, however, in the best judgment of the author, as little objectionable as any that has been proposed, and perhaps as nearly perfect as the present state of our knowledge on the subject permits. It is but partially original. In forming it, the author has preferred adopting what seemed to him best in preceding systems of classification, and modifying where modification was called for by the progress of knowledge, to any presumptuous attempt to supersede, by crude novelties of his own, plans which have in their favour the matured observation of ages, and the judgment of the soundest thinkers of past times. The present plan is a classification of results, of facts well known and generally admitted, which must remain true, whatever changes the progress of discovery may hereafter make in our views of the operation of remedies. It does not profess to explain the modes in which the results are produced. For a classification upon this principle we are not yet prepared. Our knowledge of the precise modes in which medicines act is yet too uncertain to admit of any system of arrangement, founded upon their resemblance in this respect; and it may be confidently predicted that any such system will prove unstable, as it must rest upon a fluctuating basis.

The attention of the reader is particularly requested to a few considerations, which are necessary to a proper understanding of the scope of the present arrangement. I have said that the classification is not perfect. In the first place, the remedies attached to the several classes, while they agree in the possession of the particular property which characterizes the class, often differ very much in other respects, and in some instances are applicable to very different purposes. The rule which I have adopted is to classify them, as far as possible, according to their most distinctive property, or that for which they are most valuable therapeutically, and then, in the description of each remedy, to refer to all its other remedial properties and applications, so that its individual character may be well understood. In many instances, the operation of the remedy is altogether peculiar, except in the single point in which it conforms with the other individuals of its class. Thus, while the salts of lead are astringent, they are in every other respect quite specific in their manner of affecting the system.

Again, it not unfrequently happens that a remedy, belonging to one class, has additional powers which serve to rank it in another. In such cases, the remedy is considered in both classes; being treated of at large in that with which its most important therapeutic character would rank it, and in the other only so far as may concern its categorical position. Thus, digitalis is a powerful nervous sedative, and is more strongly characterized, and probably more used as such than in any other capacity; but it is also a very efficient diuretic. It is, therefore, treated of in general, among the nervous sedatives; while, among the diuretics, it is again referred to, but only in relation to the property which attaches it to that class. Indeed, there are some remedies which, in this manner, may be ranked in several classes; as the antimonials, for example, which, while they are chiefly arterial sedatives, belong also to the emetics, diaphoretics, and expectorants. Nor is there any inconvenience in considering medicines in this way. In therapeutics, it is not any particular medicinal substance or remedial agent that we have in our minds, but the condition of disease calling for certain remedial influences; and it is important that our knowledge should be so arranged in the memory as most readily to suggest what particular remedy may be best calculated to exert this influence. This object will certainly be better attained by ranking all the remedies together calculated to meet each indication, and to have them thus associated in our minds, than by having the whole character of each body, in all its different relations and applications, impressed upon us in one exclusive view. Thus, it will be more useful practically, when we have occasion for an arterial sedative, emetic, expectorant, or diaphoretic, to have tartar emetic associated with each of these classes in our recollection, than to know it only as an antimonial, having a great diversity of properties, and thus to be compelled to think over it, along perhaps with a number of other bodies, in order to ascertain whether any one of these properties may suit our present purpose.

In reference to the modes of operating of the several remedies in producing the effects which serve to classify them, I shall offer and enforce those views which seem to me most in accordance with reason and experience, not omitting, however, to allude to others which may have been advanced, and wishing always to be understood as consider our knowledge upon this point to be in great measure provisional, liable to be materially modified in the progress of discovery.

PART II.

SPECIAL THERAPEUTICS AND PHARMACOLOGY.

DIVISION I.

SYSTEMIC REMEDIES.

Subdivision I.

GENERAL REMEDIES.

CHAPTER I.

General Stimulants.

SECTION FIRST.

Permanent Stimulants.

CLASS I.

ASTRINGENTS.

ASTRINGENTS are remedies which produce contraction of the living tissues. I do not here refer to the visible contraction which takes place in muscles under the influence of the will, or other excitant agency; but to a certain shrinking or condensation of structure, which is not attended with visible movement, but is nevertheless very obvious in the result, as in that well-known state of the skin called goose-flesh, produced by exposure to cold. That astringents have this effect locally, is proved by the obvious diminution of bulk in any part of the surface to which they may be applied, and by the strong puckering sensation occasioned by them when taken into the mouth. There can be no doubt that they operate upon the mucous membrane of the stomach and bowels, when brought into direct contact with it, in precisely the same manner as upon the mouth and skin. It has been denied that their operation extends beyond the surface of application; but the effects obtained by their use in disease can be explained only by the admission, that they exert upon the system at large their characteristic influence; though it must be allowed that their general are much less than their local effects. It is not impossible that a portion of the constitutional impression produced by them may be the result of sympathy or nervous communication; in like manner as the similar effect of cold upon the skin is transmitted to certain internal parts. But this explanation is not necessary to account for the result. Experiment has satisfactorily proved that astringents are absorbed; and the probability is that they are conveyed everywhere with the blood, and thus act everywhere by direct contact.

The fact, recently ascertained through the experiments of Bernard, that one of the functions of the sympathetic nerve-system is to produce contraction of the capillaries, very much facilitates the explanation of the general action of astringents. It is highly probable that, reaching the sympathetic centres through the circulation, they excite these centres to increased action, and thus, in part at least, produce the contraction which is their most characteristic effect. This explanation does not in any degree invalidate the idea that they act also directly on the tissues through the blood. There is nothing in the least inconsistent in these two modes of operation, which may be in action at the same time, and thus conjointly produce greater effects than either separately.

1. Mode of Operation.

Dead animal structure, submitted to the action of astringent substances, especially to those of vegetable origin, has long been known to undergo condensation, in consequence of chemical combination between constituents of the tissue and the astringent substance. In relation to the vegetable astringents, their tannic acid unites with the albumen and gelatin of the animal product, to form insoluble tannates, as in the preparation of leather from hides; in relation to the mineral, the metallic salt or its oxide also combines with albumen, producing compounds insoluble in water. The chemical therapeutists suppose that this same reaction takes place between the astringent and the living tissue, and ascribe the effects of the medicine to this agency. But there is no proof whatever that such a combination takes place in life. It could not do so, to any considerable extent, without destructively disorganizing the part affected. The force of life opposes these chemical reactions, and successfully so long as the medicine is moderately employed. If this be applied abundantly, it may first exhaust the vital forces by the excess of vital reaction it excites; and the chemical affinities may then triumph, with the effect of destroying the life of the part. But, under such circumstances, it ceases to be a medicine, and becomes a poison. The rapidity, moreover, and amount of local astringent effect are far greater than can be explained on the chemical principle. Every one knows how sudden and great is the contraction produced in all the tissues of the mouth by a very minute quantity of alum. It appears to me absurd to ascribe all this effect to chemical combination. Even were the whole of the alum which could possibly be absorbed in such a case to combine chemically with the tissues, it could not produce an amount of contraction in any degree approaching to that really experienced. Besides, the contraction, if chemical, would be much more permanent than it really is.

The following appears to me to be the true explanation of the phenomena, so far as they are at present susceptible of explanation. All the living tissues have a certain degree of vital cohesion essential to the due performance of their functions; and this cohesion probably depends on a property of organic contractility, which is called into action and sustained by the healthy stimulus of the blood and nervous influence. If these fail, the cohesion diminishes, and a condition of relaxation takes place. Now astringent substances have the peculiar property of stimulating this organic contractility; and it is this property by which they are characterized as a class of medicines. All that we know upon the subject is that, in consequence of the contact of these substances with the tissues, the contractility of the latter is called into action, and they shrink. The effect is in no degree more singular than that a similar shrinking should take place under the influence of cold.

It is a very singular mistake, which still prevails with some writers, that astringents act especially or peculiarly on the muscles. It is true that they do increase the vital cohesion of this structure, rendering the muscle firmer, but they also act equally on every other tissue capable of shrinking; as may be distinctly seen in their effects upon the skin, and felt in their effects on the mucous membrane of the mouth.

2. Effects on the System.

The observable physiological effects of astringents are, beside the general condensation of tissue referred to, or rather as a part or result of it, shortening of fibres; diminished caliber of the arteries, veins, capillaries, absorbents, and ducts; diminished secretion, exhalation, and absorption; constipation of the bowels; and increased firmness along with contraction of the pulse. The blood becomes more coagulable, in consequence, probably, of the same influence exerted by them on the organized constituents of this fluid as on the solids. It is supposed also to be less disposed to putrefaction after death. The astringents are said to increase the appetite, and invigorate digestion. This effect they undoubtedly have, in debilitated states of the function, connected with relaxation of tissue. It is reasonable to suppose that, even in health, with a very moderate degree of their peculiar influence, they may produce some slight increase of the functions. Their effect is to bring the molecules more closely together; which may thus be rendered capable of a more energetic vital reaction. But, whatever may be the case with the perfectly pure astringents, it is certain that many of the medicines ranked in this class do exercise a tonic influence; and for this reason, that they unite positive tonic powers with their astringent property. Such is the case with the vegetable astringents, which, beside their characteristic ingredient, not unfrequently contain a bitter principle also, and with the preparations of iron, which are essentially and powerfully tonic, while they are in some degree astringent.

It must be obvious, upon a little consideration, that, though astringents are stimulant to the organic contractility, they may really prove sedative to the healthy functions, when employed too freely, or continued too long. The digestive function is necessarily impaired in consequence of the diminished secretion of gastric juice, the restrained peristaltic movement of the stomach and bowels, and the impeded absorption. As a result of this defective digestion, if from no other cause, the circulation is enfeebled, nutrition suffers, emaciation takes place, and a general reduction is experienced in the forces and functions of the system.

The above results flow from an excess of the proper astringent influence. But a still greater abuse of this class of medicines leads to other and very different effects. When applied to delicate surfaces in great excess, instead of acting simply as astringents, they become irritants. In the denuded skin they excite inflammation, and, taken into the stomach, cause gastric and intestinal pains, nausea, vomiting, and sometimes diarrhœa; their astringent influence being either prevented or overwhelmed by the irritation.

As already stated, some of them, in very great excess, overcome the vital resistance of the tissue to their chemical affinity for one or more of its constituents; and disorganization, with the death of the part, ensues. It is said that, under such circumstances, putrefaction does not readily take place, being prevented in part by the previous expulsion of the liquids, but probably in chief by a direct preservative or antiseptic effect, arising from the union of the astringent with the animal principles.

3. INDICATIONS, AND THERAPEUTIC APPLICATIONS.

The indications for the use of astringents are such as might be inferred from their physiological effects. They are three in number; 1. to check morbid discharges, 2. to obviate morbid relaxation, and 3. to check inflammation in its earliest stage. For the first two purposes they may be used either generally or locally; for the third, they must be applied directly to the seat of the inflammation. It will be most convenient to treat first of their internal, and afterwards of their external use; including under the former head only what has reference to their entrance into the stomach, under the latter all their direct local applications from without.

It must not, however, be forgotten that, in their operation upon the mucous membrane of the alimentary canal when taken into the stomach, they act as directly as upon the external surfaces; the only difference being that they cannot be applied so freely to the former, in consequence of its greater sensitiveness, the greater danger of any excess of action, and the impossibility of limiting the extent of their application, or readily removing them if found to be injurious.

a. *Internal Use of Astringents.*

1. ***To Check Morbid Discharges.*** In fulfilling this indication, astringents act by contracting the pores in the blood-vessels through which the discharge takes place. Two distinct kinds of morbid discharges are affected by them; the one consisting in excessive or deranged secretion or exhalation, the second in hemorrhage. In reference to their influence in checking the latter, the astringents are denominated *styptics*. In both, some cautions are required in their use.

When the discharge depends upon some local or general disorder which it is intended to relieve, as plethora, active congestion, inflammation, or the presence of noxious matters in the blood, the astringents are as a general rule contraindicated; and the same remark applies to what have been denominated critical discharges; though, strictly speaking, these belong in fact to one of the preceding categories. As the astringents operate in general by merely closing the avenues by which the fluid escapes, and have no effect in removing the disorder which the discharge is intended to relieve, it is obvious that they may, under these circumstances, do much mischief. If they check the discharge, they may increase the real pathological condition; if they fail, their own irritative effect is superadded to that previously existing.

Again, a discharge, though originally morbid, may have become habitual; and the processes of digestion and sanguification having taken on increased activity, the system may have accommodated itself to the drain. Astringents in such cases might disturb this balance, and give rise to dangerous local congestion, or general plethora. If resorted to, therefore, they should be applied cautiously and gradually, so as to permit the system to accommodate itself to the change; or the apprehended evil should be counteracted by other measures, as by cathartics, issues or setons, a regulated diet, and increased exercise, which may have the effect of consuming the excess of blood.

Astringents are applicable when the discharge is purely local and dependent on no coexisting disease; as, for example, in the hemorrhage consequent upon an accidental rupture of a blood-vessel, either from direct violence, or from a sudden and temporary congestion produced by straining, position, etc.

They are also applicable when the affection depends upon debility or relaxation of the coats of the blood-vessels, either original, or consequent upon previous excessive excitement, which has quite disappeared. This is a very common condition in the advanced stages of inflammation; and it is, perhaps, under such circumstances that astringents are upon the whole most useful.

Another condition which sometimes imperiously calls for them, even under otherwise opposing indications, is when the discharge is so copious as itself to become the main source of danger. Thus, a hemorrhage from the rectum, intended as a relief to serious plethora or portal congestion, may be so frequent or abundant as to put life at risk; and, in this case, should be arrested without hesitation. It is not unfrequently necessary to choose between such opposite indications; and the prudent practitioner will always prefer what may seem to him the least of the two evils.

The position, moreover, of the discharge may sometimes be such as to render this the greatest danger; as in a case of hæmoptysis which threatens to overwhelm the lungs. Here astringents may be employed, though the hemorrhage might have been the result of a congestion, and may have a tendency to relieve it. In such cases, however, the use of the styptics should be accompanied with measures, calculated, in a safer way, to accomplish the end for which the hemorrhage was intended.

Finally, there are certain individuals of this class which, with their astringent property, unite others calculated to relieve the affection in which the discharge originated, and against which, therefore, the contra-indication above mentioned has less force than against the members of the class generally. Thus, acetate of lead, while powerfully astringent, is also antiphlogistic, and may sometimes be advantageously employed to arrest morbid secretion from inflamed surfaces, when others would prove only injurious.

It is unnecessary to detail minutely all the diseases in which astringents may be useful, and the circumstances in each, which modify the indication for their employment. Guided by the above principles, the practitioner will judge for himself when the occasion may be offered. It will be sufficient, for the sake of illustration, to trace a single disease through its various therapeutical relations with astringents, in conformity with the foregoing rules, and afterwards simply to enumerate the other diseases in which they may be required, to meet the indication now in view.

Diarrhœa is one of the complaints in which astringents are most frequently employed. But this affection often depends on inflammation of the bowels, or congestion of the liver and whole portal circulation, which it has the purpose and effect of relieving. Astringents, if they succeed in checking the increased secretion, which is at once the agent of relief, and the cause of the diarrhœa, will act injuriously on the inflammation or congestion; if they fail, they will add their own irritation to that pre-existing. They are, therefore, as a general rule, improper under such circumstances. In certain kidney affections, urea accumulates in the blood, and sometimes seeks an outlet through the bowels, producing diarrhœa, which thus protects the system, in some measure, against the fatal influence of that agent upon the brain. Diarrhœa is sometimes critical; that is, occurs at the termination of certain diseases, such as idiopathic fever, and is probably one of the processes by which the system relieves itself of its morbid condition. In either of these cases, astringents might do serious injury. Lastly, the diarrhœa may have existed so long that the system has accommodated itself to the increased discharge, the sudden checking of which might occasion dangerous congestion of the liver, lungs, or brain, or perhaps dropsical effusion. Here, though astringents may not be altogether contraindicated, they should be used with caution, so as gradually to bring about the cure of the complaint; while, in the mean time, measures may be taken to obviate any threatened injury.

There is reason to believe that diarrhœa sometimes results from a pure relaxation of the mucous membrane of the bowels, permitting the liquid parts of the blood to pass through the walls of the capillaries, almost as through dead membrane. Very frequently inflammation of the mucous coat ends in such a state of debility or relaxation. The vessels, dilated in the active stage of the disease, with pores also probably enlarged so as to admit the passage of the liquor sanguinis, retain this condition upon the cessation of the excitement; and the extravasation and consequent diarrhœa continue long after the occasion for them has ceased. It is under such circumstances that astringents prove most useful in this affection.

Another very frequent occasion for their use in diarrhœa is when the discharge, no matter what may have been its origin, is so profuse as to endanger the safety of the patient. Such is the case in epidemic cholera; and I have repeatedly known patients in danger of their life from copious white alvine evacuations, dependent on portal congestion from inertness of the capillaries of the liver. Here astringents are sometimes indispensable.

In cases of diarrhœa connected with vascular irritation of the mucous membrane, perhaps with some degree of acute inflammation, and very often in chronic inflammation, it may be proper, even though the discharge may not be immediately dangerous by its quantity, to employ astringent medicines, having along with their astringency a sedative or alterative property, which renders them useful in the treatment of the irritation or inflammation itself; and, when a very exhausting discharge, originating in such causes, imperiously demands the employment of astringents, it is to this set of them that we should preferably have recourse. Acetate of lead is indicated in the more acute of these cases, and sulphate of zinc, sulphate of copper, or alum in the more chronic; the first from its sedative, the three latter from their alterative action upon inflamed surfaces.

Dysentery is another complaint in which astringents are frequently recommended by writers. But a cautious discrimination is here necessary, in order to avoid the most serious consequences; and, in ordinary acute dysentery, in the earlier stages, it is I think best to avoid entirely their internal use, even that of acetate of lead, which has been commended by some. In the advanced stages, when the discharges have become more copious, the grade of the inflammatory excitement greatly reduced, and the patient's strength exhausted, they may sometimes be employed with benefit; though, even under such circumstances, caution should always be observed. In the chronic form of the disease they are not unfrequently useful, particularly in warm climates, where there is greater laxity of system, and especially of the bowels, demanding the use of this class of remedies. The metallic alterative astringents are most efficacious in these cases, though the vegetable are also not unfrequently employed.

Other morbid secretory affections, in which the internal use of astringents is called for, are *diuresis* or excessive secretion of urine, *profuse and exhausting sweats*, *catarrh of the bladder*, *excessive bronchial secretion*, and sometimes possibly *dropsical effusion* dependent on relaxation of the tissues. In these complaints they are less obviously efficacious than in those of the bowels; because, in the latter, they are brought directly into contact with the diseased tissue, while, in the former, they must reach it through the medium of absorption. A rule in these cases is to select the particular astringent which experience has shown most readily to reach the seat of the discharge. Thus, uva ursi and chimaphila are especially useful in the affections of the urinary passages, from their well-known quality of impregnating the urine.

Hemorrhages often demand the use of astringents; and the general rules before given hold, in relation to this set of discharges, as well as to morbid secretions and exhalations. When active, and connected with plethora or local vascular irritation, unless alarming by their quantity, or injurious by their position, they should be treated hesitatingly with astringents; and, should this class of remedies be indispensable, those should be selected which are sedative as well as styptic, such as cold, and the preparations of lead. After the relief of the plethora or congestion, and a sufficient reduction of the active character of the hemorrhage, either by depletory measures, or in the course of the complaint, astringents may be employed without hesitation, and without any special reference to their antiphlogistic properties. In *passive hemorrhages* no particular caution is requisite; the free use of astringents being almost always indicated in these. Besides the mere property of closing the bleeding orifices, it is probable that many of the astringents exercise another power in arresting hemorrhage; that, namely, of increasing the coagulability and plasticity of the blood.

2. *To Obviate Morbid Relaxation.* In most instances morbid relaxation is attended with morbid discharge, and the two indications are answered at the same time. But occasionally there is an unhealthy laxity of the non-secreting tissues; and even the secreting may be affected in the same way without increased extravasation. *In scrofulous diseases*, and other cachectic affections dependent on defective or depraved nutrition, this condition is not uncommon; and astringents have accordingly been much and advantageously used in their treatment. In the *convalescence from febrile and other acute diseases*, especially when somewhat protracted, the same condition not unfrequently exists, calling for the same remedies. It is probable that sulphuric acid and the chalybeates, so much employed under these circumstances, may prove useful as well by their astringent as their tonic virtues. In *chronic inflammation of the mucous membrane of the stomach and bowels*, when all acuteness is passed, and the blood-vessels are merely passively distended, or ulcerations exist, which, in consequence of the laxity and feebleness of the tissue, are unable to take on the healing process, there would appear to be an indication for astringency; and the fact is, that, among the most efficient remedies in such affections, are some of the mineral substances belonging to this class, as sulphate of iron and sulphate of copper.

3. *To Check Inflammation.* The indication for astringents in the early stage of inflammation, founded on their property of contracting the vessels, and thus excluding, in some measure, the blood necessary for the support of the inflammatory process, can seldom be fulfilled by their internal use. To answer this purpose, they must be brought to act upon the inflamed vessels in a more concentrated state than would be safe, or indeed possible, in the blood, through the medium of absorption; and they would consequently be wholly inapplicable to any inflammatory affection, the seat of which could be reached only through the circulation. Even in inflammations of the alimentary canal, there would be too much risk that, if used largely enough to have any powerful effect, they might act more disadvantageously as irritants to the sound parts, than usefully as astringents upon those inflamed, as it would be impossible to limit their application to the latter; and, besides, there is always difficulty in deciding, whether the inflammation has not passed the point at which any good could be expected from them. Hence, the astringents can seldom be used internally, with the view of rendering commencing inflammation abortive; and it is only externally or topically, that, as a general rule, they can be beneficially applied upon this principle.

b. *External Use of Astringents.*

The same indications exist for the external or topical as for the internal use of astringents; and they are even more effectual by the former method than the latter.

1. *For arresting morbid discharges* they are employed in excessive secretion, resulting from advanced or chronic inflammation, or debility of the vessels, in the nostrils, conjunctiva, external auditory meatus, mouth and fauces, urethra and bladder, vagina and rectum. Hence their use in *chronic coryza* and *ozæna, purulent ophthalmia, otirrhœa, stomatorrhœa, gonorrhœa and gleet, cystirrhœa, leucorrhœa*, and *mucous* or *purulent rectal discharges. Excessive sweating*, and *œdema of the limbs*, may also be treated by them with advantage. They are the most effective remedies in *hemorrhages* from all these sources. The same caution should be observed, as in their internal use, not too hastily to arrest a discharge which is effecting some useful purpose. But they may sometimes be employed with propriety topically, where we might hesitate to administer them by the mouth, and almost always with much greater freedom. Any irritation they may excite in external parts is much less hazardous than an equal amount in the stomach or bowels. Besides, we can in this topical method precisely limit their application, if deemed advisable, and, should they act too powerfully, may remove them. They may, moreover, be used much more effectively than by the stomach, because in a more concentrated state.

2. For *obviating relaxation*, not essentially connected with excessive discharge, they are employed in a great variety of affections, as in the different forms of venous distension, including *varicocele, hemorrhoids*, and *varicose veins of the legs;* in *prolapsed anus, uvula*, and *uterus;* in *indolent, flabby*, and *fungous ulcers;* and in various other conditions of local debility, attending or following advanced and chronic inflammation of the different surfaces mentioned in the preceding paragraph, and additionally in that of the larynx.

3. In the *forming or early stage of inflammation*, with the view of contracting the capillaries, the astringents are much and most usefully employed. When, however, that process is in full vigour, and sustained by a plethoric state of the blood, or some cause acting strongly through the constitution; when, too, exudation has taken place in the tissue, and blood may have coagulated in some of the vessels, astringents will often fail to produce their characteristic effect, and may even increase the inflammation by acting as irritants. But, even under such circumstances, after the activity of the inflammation has been subdued by depletion, they may again be resorted to, and will now not unfrequently succeed where they had before failed. Hence, astringents are used locally in *inflammation of the conjunctiva, of the mouth and fauces, of the rec-*

tem, of the mucous membrane of the genito-urinary passages, and *of the skin.* It is upon this principle, in part, that they operate so usefully in various *cutaneous eruptions.* But, in the choice of astringents for these purposes, there is great occasion for the exercise of judgment. From their diversified powers, some are applicable where others might prove injurious. It is obvious that those which possess other antiphlogistic powers, besides astringency, must be more efficient in answering the indication than the pure astringents. Hence, the mineral are generally more efficacious than the vegetable substances belonging to the class.

4. DIVISION OF THE ASTRINGENTS.

There is sufficient ground for arranging astringent medicines in two sections, one including the vegetable, and the other those of mineral origin.

1. The *vegetable astringents* are distinguished by a striking similarity of properties, which has been ascertained to depend on the presence of a peculiar proximate principle, or set of principles, denominated *tannin* or *tannic acid.* Though this, as found in different products, has been ascertained to differ somewhat in chemical character, yet, both in this respect, and in its sensible and therapeutical properties, it is so nearly identical that, in relation to its medical uses, it may be considered as one substance. It is undoubtedly the main astringent principle. This rank was at one time claimed for *gallic acid*, which is associated with tannic acid in certain astringents; and there are some who seem disposed to revive this claim; but it is quite sufficient simply to taste the two principles, to be convinced that gallic acid is incomparably inferior in styptic power, and that little of the effects produced by astringent vegetables can be justly ascribed to it. The fact would seem to be, that it is more readily absorbed than tannic acid, probably because it does not like this form insoluble compounds with albumen and gelatin; and its constitutional effect is probably greater in proportion to its local than is the case with the more astringent substance; but, when it is understood that the vegetable astringents which have been most used internally, and in favour of which experience has spoken most decidedly, contain no gallic acid, as kino, catechu, and extract of rhatany, its claim to be considered the prominent astringent principle must be admitted to be extremely feeble. Tannic acid seems to be purely astringent, and destitute of any other physiological property. The vegetables, therefore, which contain little or none of any other active principle than this, may be looked on as proper representatives of the class. But these are very few. Most of the vegetable astringents contain also a bitter principle, which somewhat modifies the influence of their tannic acid, and might entitle them to rank with the tonics, which they considerably resemble in their effects. But, so far as their mere astringency is concerned, they are essentially

different from that class of medicines; resembling them only in this single point, that, in cases of debility connected with deficient vital cohesion of the tissues, they increase strength by restoring to the tissues the compactness necessary for the proper exercise of their functions. It is obvious that the bitter astringents are less applicable than tannic acid itself, or the pure astringents, to those cases in which it is desirable to stimulate, whether locally or generally, as little as possible.

2. The *mineral astringents* have in general nothing in common but their astringency. Each has peculiar properties of its own, which render it applicable to peculiar purposes. Thus, the preparations of lead are sedative, alum has an alterative influence, sulphuric acid is refrigerant and tonic, and the preparations of iron have remarkable tonic powers, and a peculiar power of modifying the blood. Between the sulphates of zinc and of copper, however, there is a remarkable coincidence of properties, though the latter is vastly more powerful than the former.

COLD, AS AN ASTRINGENT.

Cold is primarily sedative, and secondarily stimulant through reaction. Its astringent influence, in relation to which alone it is here considered, is merely incidental to the sedative. The effects are essentially the same as those already described as the result of the action of astringents generally, and need not be repeated. The *cutis anserina*, or goose-flesh, in which the roughness is owing to the shrinking of the skin around the prominent sebaceous and hair follicles, is even more striking than the similar effect from other astringents. There is also from cold a greater degree of stiffness or firmness in the contracting tissue.

1. *Mode of Operation*. The astringent effect of cold is partly physical, and partly vital. It is a general law of heat, that bodies expand with its increase and contract with its diminution; and the contraction produced in living structure by cold is in some measure undoubtedly the result of this law. The peculiar density and stiffness of tissue may be ascribed, in part, to the solidification by cold of the oil globules of the adipose matter. But I am disposed to ascribe the diminution of bulk still more to the sedative influence of the cold upon the vital forces of the part, and the consequent inability of the capillaries to receive and carry forward the blood. According to this view, it is rather the part which shrinks, because the blood does not enter it in normal proportion, than the blood that is expelled, because the capillaries are contracted; though the two causes probably co-operate. It is not impossible that a diminution of heat may, in some unexplained manner, act as a stimulant to the organic contractility, exactly in the same mode as the medicinal astringents; but the former explanation is more accordant with the re-

ceived views of the sedative influence of cold, which would seem to be a necessary corollary to the stimulant action of heat. There can be no doubt that the astringent influence of cold is transmitted, through nervous communication, from the external surface where it is applied, to certain internal surfaces, especially those of the respiratory and alimentary mucous membranes, and the lining tissue of the uterus.

The progress of physiology, since the publication of the first edition of this work, enables us to advance one step further in explaining the contraction produced by cold, though, it must be confessed, still somewhat conjecturally. It has been determined that one of the offices of the cerebral nerve-centres is to promote active capillary expansion, while the ganglionic system has a directly contrary effect. Now it is not improbable that the depressing influence of cold, transmitted by direct nervous connection to the cerebral centres, may diminish this expansive action of the former, while the shock it produces on the point of application may prove excitant to the latter, and thereby produce contraction in the capillaries; the two influences, though so different in their nature, thus co-operating to the same result.

2. *Therapeutic Effects.* The therapeutic effects of cold as an astringent are, for the most part, the same as those of the class in general. It is, however, seldom resorted to with the view of checking morbid secretion. Sometimes it is used to moderate or arrest excessive sweating, but cautiously, and with much reserve. By far the most extensive and useful application of this agency of cold is to the suppression of hemorrhage. In this it exhibits extraordinary powers. The effect is generally ascribed to the closure of the bleeding orifices, and no doubt correctly in part; but I am inclined to think that still more is due to the depression of the local circulating forces through the sedative influence of the cold. The styptic effects of the remedy have also been attributed, in some measure, to an increased coagulability of the blood; but this is probably a mistake; as cold retards rather than hastens coagulation, and for a very good reason; for, otherwise, exposure to a very low temperature might endanger coagulation of the blood, and consequent inevitable gangrene, in the most exposed parts. Blood may even be frozen without coagulating, and, upon thawing, may still retain the property. Hence, frozen parts may by proper management often be restored, which could not happen if the blood had all coagulated in the vessels. Almost all forms of hemorrhage may be treated advantageously by cold, unless the vital forces have been so much prostrated as to be able to bear no further reduction.

This remedy is less applicable, than other astringent measures, to the treatment of simple relaxation; at least in reference to its direct and primary action. It may, however, sometimes be advantageously used in varicocele, and in hemorrhoidal and aneurismal tumours. It has been employed also to aid in the reduction of strangulated hernia, in which it is supposed to be useful by diminishing the bulk of the contents of the sac, in greater degree than it contracts the hernial orifice, so as to favour the return of the former through the latter; but this is scarcely an example of the mode of operation here referred to.

For fulfilling the third indication for the use of astringents, that, namely, of *obviating early inflammation* by emptying the vessels, cold is an admirable remedy; but it is still more useful in that affection as a sedative, and will be fully treated of, in relation to its antiphlogistic action, under the head of sedative remedies.

3. *Modes of Application.* Cold as an astringent may be applied by means of cold air, cold water, ice or snow, evaporating liquids, and frigorific mixtures. *Cold water* may be applied upon linen rags or towels, by means of the douche, or by affusion, and may vary in temperature from 32° to 60°, according to the amount of effect desired. *Ice* and *snow* may be applied in bladders, or wrapped up in cloths; and the former may be used in larger or smaller fragments, or finely pounded. *Ether* is the liquid most frequently employed with a view to the production of cold by evaporation; and its effects in this way may be greatly increased by blowing on it, by means of a pair of bellows, as it is dropped upon the surface. Brought, in the state of spray, by means of the atomizer, into contact with any part of the body, it is capable of producing an intense degree of cold, so as to act as a complete local anæsthetic; but of this application of the liquid more will be said hereafter. The most convenient *frigorific mixture*, in the absence of cold water or ice, is made by mixing, in a pint of water, four ounces of sal ammoniac and the same quantity of nitre, which may be applied in a bladder.

The following applications are made of cold in one or another of the above forms. Cold air is sometimes useful in arresting *traumatic hemorrhage*, and *checking profuse perspiration*. In the same kind of hemorrhage, very cold water or ice may sometimes be advantageously resorted to, when the bleeding vessels are too small to be tied, or not conveniently reached, as in some operations about the rectum, vagina, etc.

In *epistaxis* the water or ice may be applied over the nose, to the back of the neck, to the genitals in obstinate cases, or by affusion to the head.

The same application may be made, in very obstinate *hæmoptysis*, to the breast or axilla; but in this variety of hemorrhage the remedy should be used with caution, from the danger of producing congestion in the pulmonary parenchyma.

In *hæmatemesis*, the most effectual method of employing this remedy is to allow the patient to swallow small pieces of ice, which, by dissolving in the stomach, will keep up a constant frigorific effect on the organ. There might be danger, in the external use of cold in this affection, of producing congestion of the portal circle, which might more than counterbalance the sympathetic astringent effect on the mucous membrane.

In *hæmaturia*, *uterine hemorrhage*, and *bleeding from the rectum*, the applications may be made over the sacrum, to the perinæum, and over the pubes; and the douche, falling from a considerable height upon the lower part of the abdomen, is often more efficient than the simple contact of the water or ice. Very cold water has sometimes been injected into the rectum and vagina; and pieces of ice have been introduced into the same cavities, and even into the uterus, when a very strong impression was desired.

In *varicose swellings* and *aneurismal tumours*, one or another of the several modes of application mentioned may be employed, according to the situation of the part, or other circumstances affecting their convenience or efficiency. In *strangulated hernia*, recourse has been occasionally had to the evaporation of ether, as well as to other frigorific measures, especially to pounded ice or snow in cloths or bladders.

But in all these cases, especially when ice or snow is employed, care should be taken not to allow so long a continuance of the application as to endanger the freezing and consequent mortification of the part; and, when ice is introduced either into the stomach or rectum, to guard with special caution against a too great depressing effect.

◆

I. GALLS.

GALLA. *U.S.*, *Br.*

Origin. Galls are excrescences upon the young branches of *Quercus infectoria*, a small tree growing in Asia Minor, Syria, Persia, and other parts of central Asia. They result from punctures in the tender shoots, made by an insect, which deposits its egg in the puncture. They are brought from the Levant and India.

Sensible Properties. Galls are spherical, varying in bulk from the size of a pea to that of a large cherry, studded with small tuberosities, but smooth in the intervals; of a dark-bluish, greenish, gray, or yellowish-white colour; inodorous, and of a bitter, very astringent taste.

Varieties. There are two varieties, one denominated *blue, green*, or *black galls*, the other *white galls*. The former are smaller, harder, more compact, relatively heavier, and of a darker colour than the latter, and, having been gathered before the escape of the insect into which the deposited egg has become developed, have no hole leading to their interior. The *white galls* are large, light, frequently hollow in the centre, generally of a dirty yellowish-white colour, with a round perforating hole in their surface, through which the insect has escaped; and are much inferior in astringency to the other variety.

Active Principles. These are *tannic acid,* of the variety which forms bluish-black precipitates with the salts of the sesquioxide of iron; *gallic acid;* and probably a distinct *bitter principle.* It is the tannic acid upon which the virtues of the medicine chiefly depend. Galls impart their active properties to water and alcohol.

Incompatibles. A strong infusion yields precipitates with concentrated muriatic and sulphuric acids; lime-water; the carbonates of potassa and ammonia; the soluble salts of iron, manganese, lead, and copper; the nitrates of silver and mercury; tartar emetic; the infusions of all vegetable substances which contain an organic alkali, as opium, ipecacuanha, Peruvian bark, etc., and of various other active vegetable medicines, as columbo and digitalis; and solutions of starch, albumen, and gelatin.

Effects on the System. As galls contain a very large proportion of the astringent principle, they are among the most powerful medicines belonging to the class. Their effects are those already described in the general observations on astringents; but they exercise also some tonic influence, probably connected with their bitterness.

Therapeutic Application. Though not less efficacious than other astringents, in the diseases in which simple astringency is indicated, they are little used internally; and of late have been almost entirely superseded by the tannic acid extracted from them, which has their astringent virtues, in a concentrated state, without their bitterness. They are, however, occasionally used in *diarrhœa;* and may be advantageously employed in *obstinate flatulence* and *tympanites,* dependent upon an atonic state of the stomach and bowels. I have, in this affection, prescribed with great apparent benefit an infusion of galls and fennel-seed, made in the proportion of half an ounce of the former, and two drachms of the latter, to a pint of boiling water, and given in the dose of a small wineglassful three times a day. It probably acts, in the correction of flatulence, in some degree, by constringing the capillaries, and preventing the evolution of gaseous matter from the blood.

Galls have been recommended as an antidote to the vegetable alkaloids, and the medicines containing them, as opium, belladonna, stramonium, hyoscyamus, conium, and nux vomica, upon the supposition that, the tannates of these principles being insoluble in water, they are rendered less active by the combination. But it has been shown that, in respect to one at least of these alkaloids, namely quinia, the tannate is scarcely if at all less efficacious than the soluble salts; and the same is probably true of all of them. Galls should not, therefore, be relied on as an antidote in any case of poisoning with these organic alkalies, whether isolated or in their native state of combination; and, if exhibited at all, should be used merely as an adjuvant to measures calculated to evacuate the poison from the stomach and bowels. The same may be said of their presumed efficacy in cases of poisoning from tartar emetic; at least this antimonial has been repeatedly known to vomit actively, when prescribed, in the ordinary emetic dose, in connection with substances containing tannic acid.

Administration. The *dose* of powdered galls is from ten to twenty grains, which may be given three or four times a day. An *infusion*, made in the proportion of an ounce to a pint of boiling water, may be administered as often in the dose of a wineglassful.

The *officinal Tincture* (TINCTURA GALLÆ, *U. S.*) is more used as a chemical test than as a medicine, but may be given in the dose of from one to three fluidrachms. By time and exposure the tannic acid contained in it is apt to be converted into gallic acid; and its virtues, whether as a test or as a medicine, may be thus impaired.

A powerfully astringent preparation was much used, in obstinate cases of diarrhœa, by the late Drs. Physick and Parrish, of this city, made by introducing into a cup two or three drachms of coarsely powdered galls, pouring over the powder three or four fluidounces of brandy, putting upon iron skewers placed near each other over the top of the cup several pieces of loaf sugar, then setting fire to the brandy, and allowing it to burn until the alcohol was so far consumed that it would burn no longer. The sugar was melted in the flames, and, falling into the liquid, made a rich syrup, which was carefully poured off from the dregs, and given in the dose of a fluidrachm.

Externally galls are much and efficaciously employed. In the form of *infusion*, prepared as above mentioned, the medicine may be used as a gargle in *chronic angina* and *relaxed uvula*, as an injection in *gleet*, *leucorrhœa*, and *prolapsus of the uterus and rectum;* and as a lotion in *piles* and *flabby ulcers*. A strong decoction, made by boiling an ounce and a half of galls, for fifteen minutes, in half a pint of water, and filtering, has been strongly recommended in chilblains, with or without ulceration; being applied two or three times daily to the diseased surface.

The *Ointment of Galls* (UNGUENTUM GALLÆ, *U. S.*), made by rubbing one part of powdered galls with seven parts of lard, is an excellent local application in *piles, prolapsus ani*, and *flabby* and *indolent ulcers;* and may be rendered still more efficacious, in the two former affections, particularly when in an irritated state, if combined with a little powdered opium, as in the *Unguentum Gallæ cum Opio* of the British Pharmacopœia, which contains thirty-two grains to each avoirdupois ounce of the simple ointment of galls, equivalent very nearly to thirty-five grains to the troyounce.

Two officinal preparations considerably used are made from galls, namely, *tannic* and *gallic acids*.

1. TANNIC ACID.—ACIDUM TANNICUM. *U. S., Br.*—*Tannin of Galls*—*Gallo-tannic Acid.*

Origin. This is the variety of tannic acid which precipitates the salts of sesquioxide of iron of a bluish-black colour. Besides galls, it is found in different products of the oak, and in other vegetable astringents. Other varieties of tannic acid precipitate the salts of iron of a greenish-black or grayish-black colour, and are apt to be associated with a reddish or reddish-brown colour in the medicine containing them, as in kino, catechu, and rhatany. These all differ from that now under consideration, in not being convertible into gallic acid, upon exposure in the state of infusion to the atmospheric air. They probably differ among themselves, and may be distinguished from the tannic acid here referred to, and from one another, by designative epithets derived from the medicine. Thus, the variety derived from kino may be called *kino-tannic* acid, that from catechu, *catechu-tannic acid*, etc. Tannic acid is extracted from galls by means of ether containing a little water. The liquid is passed through powdered galls, and after passing separates into two layers, the lower of which holds the tannic acid in solution, and yields it on evaporation.

Sensible and Chemical Properties. Gallo-tannic acid is solid, spongy, light, white with frequently a yellowish or greenish-yellow tint, inodorous, and of a strongly astringent taste, without bitterness. It is freely soluble in water, less so in alcohol and ether, and insoluble in the fixed and volatile oils. Its *incompatibilities* are the same with those of galls (see *page* 112), which owe their chemical relations with other substances chiefly to this principle. Exposed in solution to the air, it is slowly changed into gallic acid, with the escape of carbonic acid.

Effects on the System. Tannic acid, being the peculiar active principle of the vegetable astringents, must affect the system in the same manner as these medicines, so far as their astringency is concerned, with this difference only, that it exceeds them all greatly in power. In reference to topical effect alone, it is probably the most energetic astringent known. In its general action, it is inferior to some of the mineral substances belonging to the class. In consequence of its strong affinity for some of the proximate constituents of the tissues and of the blood, as albumen, gelatin, and fibrin, with which it forms insoluble compounds, it is probably never taken unchanged into the circulation. Indeed, it could scarcely exist as tannic acid in the blood. Experiments with tannic acid upon dogs have shown that, when it is given freely to these animals, the urine becomes darker, and yields evidences, upon chemical examination, of the presence of gallic and pyrogallic acids. Into these acids, therefore, or into something intermediate between them and itself, the tannic acid is probably converted on entering the circulation. This presumption is rendered more plausible by the fact, that gallic acid does not, like the tannic, form insoluble compounds with the animal principles above mentioned. Now, as this acid is far less astringent than the tannic, we can readily account for the much greater power of the latter as a local than as a general astringent. Among its local effects are of course those which it produces in the bowels; for with the mucous membrane of these it is brought into as close contact as with the skin.

In moderate doses, tannic acid is said to produce warmth in the stomach, and somewhat to excite the appetite. It undoubtedly tends to diminish the number and quantity of the stools. Largely given, it causes a feeling of constriction in the epigastrium, not unfrequently nausea, and sometimes obstinate constipation. But it is asserted that a drachm or more may be given, in the course of a day, not only with impunity, but with advantage, if it be administered in the liquid form, or followed, if in the pilular form, by food or drink; and, in these large doses, it is said greatly to increase the secretion of urine. (P. Garnier, *Archives Générales*, Janv. 1859, pp. 28–35.)

Therapeutic Application. When pure astringency is required, tannic acid is preferable to the crude medicines containing it, from its comparatively small dose, its less unpleasant taste, its less liability to offend the stomach, and from the circumstance that, not being associated with principles having a different action from its own, it can be given in cases in which the crude medicine, in consequence of containing such principles, may be contraindicated.

1. *Internally*, it may be used most advantageously in affections of the stomach and bowels, with the inner surface of which it comes into direct contact. In all cases of *diarrhœa* and *chronic dysentery*, demanding the use of astringents, especially in the former of these diseases, it is very useful. It may even be employed in these affections, in some instances, when the medicines containing it could not, in consequence of associating too much of a tonic or stimulating property with their astringency. In *cholera infantum* it may frequently be associated usefully with the other medicines employed. It is asserted to have produced extraordinary effects in *epidemic cholera*, in which it may be given at any stage so long as copious evacuations continue. From the rapidity and violence of this disease, it must be used more largely than in most other affections; from five to ten grains being required, to be repeated every half hour or hour until the discharges are checked. In *hemorrhage from the stomach and bowels*, not connected with high vascular irritation or acute inflammation, it is an excellent remedy. In *hæmatemesis* it should be given preferably in solution, as it will thus act more promptly and equally upon the bleeding surface. In *intestinal hemorrhage*, on the contrary, the pilular form is to be preferred, because, in this state, the medicine will be more likely to pass through the stomach unaltered, and thus reach the seat of its destined action. In all these

affections, it should generally be combined with opium, and often also with ipecacuanha, the proportions of which should vary to suit the particular circumstances of the case. Acetate of lead is generally indicated at the same time. Should this and the tannic acid have been employed separately without success, they may be given conjointly; for, though the tannate of lead would be formed, yet there is reason to suppose that this might prove more efficacious, in certain cases, especially in the intestinal affection, than either of the two medicines alone.

Though less efficacious in complaints the seat of which it cannot directly reach, tannic acid has yet been highly recommended, as an internal remedy, in various morbid discharges, whether secretory or hemorrhagic, proceeding from other sources than the alimentary canal. *Profuse and exhausting expectoration, whether mucous or purulent, colliquative sweats, excessive diuresis, chronic catarrh of the bladder, hæmoptysis, hæmaturia*, and *menorrhagia*, are the affections of this kind in which it has been used. But in all of them I should prefer the mineral astringents; and the probability is that gallic acid might prove little less effective than the tannic. It is said, given to the extent of nine grains daily, to have proved very serviceable in cases of *purulent infection* or *pyæmia*, in which sulphate of quinia was thought to have acted injuriously. (*Med. T. and Gaz.*, Aug. 1862, p. 149.)

Dr. S. Scott Alison recommends the acid as an excellent remedy in *dyspepsia*, in which he states that it promotes the appetite, relieves flatulence, and not unfrequently, instead of constipating, produces a healthy action of the bowels. It would probably prove not less efficacious than galls, in *obstinate flatulence* and *tympanites* dependent on relaxation of the bowel. It is asserted to have been very successful in the cure of *intermittents*, and has been given as an *anthelmintic*, in the dose for children of from five to ten grains. It has been strongly recommended in *dropsy with albuminous urine*, in the quantity of from thirty grains to a drachm in twenty-four hours. (*Arch. Gén.*, Janv. 1850, p. 35.) Tannic acid has also, like galls, been recommended as an antidote to the poisonous vegetable alkaloids, and certain metallic salts, especially tartar emetic; but, for reasons already mentioned, it should not be relied on to the exclusion of other measures. (See *pages* 112–3.)

Administration. The dose is from two to ten grains, to be repeated, in chronic cases, three or four times a day; in those requiring a speedy impression, every hour, two, or three hours. The medicine may be given in pill or solution. In the latter form, it is best administered in connection with syrup; which may be either simple, or medicated by the addition of some agreeable flavouring substance, as one of the aromatic volatile oils or tinctures. Syrup of orange peel or of ginger may be used for the purpose. The strength of the solution should be such, that from one to four fluidrachms may contain the required dose of the medicine.

2. *Externally*, tannic acid may be used for all the purposes for which astringents are indicated, and will be found among the most effective of them. It has been specially recommended in the *purulent ophthalmia* of infants; in *epistaxis* and *chronic coryza;* in *common and pseudomembranous angina, prolapsed uvula, ulcerous affections of the mouth and fauces, excessive salivation, bleeding and spongy gums, bleeding from the socket of an extracted tooth,* etc.; in *gonorrhœa, gleet, leucorrhœa,* and *prolapsed uterus;* in *bleeding from the rectum, prolapsus ani,* and *hemorrhoidal affections* generally; and finally, in *flabby* and *fungous ulcers,* and *various eruptive affections.* In these complaints it may be used in solution, powder, or ointment. For injection into the eye, the nostrils, the urethra or vagina, and the rectum, and for gargles, *the form of solution* should be used, the medium strength of which may be five grains to the fluidounce of water. A much stronger solution, containing one part of the acid to three of water, has been recommended in purulent ophthalmia, and for ulcers and specks on the cornea; while one considerably weaker, containing not more than a grain or two in the fluidounce, to begin with, may be used as a collyrium in commencing or retreating inflammation of the conjunctiva, of the catarrhal character. Indeed, it is asserted that from one to two drachms in the fluidounce of water may be employed in common acute ophthalmia, dropped into the eye, not only without inconvenience, but with extraordinary curative effect. (G. R. Sheraton, *Med. T. and Gaz.*, Sept. 1863, p. 272.) A solution of the strength of a drachm to the fluidounce has been strongly recommended in *chilblains. Nævi* have been cured by the injection into them of a solution of the same strength. (Haynes Walton, *Med. Times and Gaz.*, xvi. 612.) As a local application tannic acid has also been employed dissolved in *glycerin,* and has proved very advantageous in the hands of some practitioners. *In the form of powder,* it has been used in epistaxis, being snuffed up by the nostril, or blown up through a quill; and as a remedy in spongy gums, and foul old and bleeding ulcers, to which it may be applied by sprinkling or dusting it over the surface. It has been thought to be very efficacious in *chronic inflammation of the lachrymal sac;* being applied, by means of a fine camel's-hair pencil, to the vicinity of the puncta lachrymalia, after the matter has been evacuated from the sac by pressure.

An ointment is now officinal (UNGUENTUM ACIDI TANNICI, *U. S.*), made by rubbing thirty grains, first with thirty minims of water into a paste, and afterwards with a troyounce of lard; and the preparation may be weakened by adding any desirable quantity of lard. In this form it may be used in piles, cutaneous eruptions, sore nipples, old ulcers, and chronic inflammation of the uterus and vagina. In the *form of lozenges* (TROCHISCI ACIDI TANNICI, *Br.*), each containing half a grain of the acid, it may be employed in cases of chronic angina and relaxation of the uvula; the lozenge being held in the mouth, and swallowed as it slowly dissolves.

Becquerel has found great advantage, in cases of chronic disease of the uterus, from the introduction into the cavity of the organ of cylindrical sticks of tannic acid, about an inch long by two or three lines in diameter, made by rubbing four parts of the acid, and one of tragacanth, with enough crumbs of bread to give them due plasticity. (*Ann. de Thérap.*, A.D. 1860, p. 164.) Sir J. Y. Simpson, of Edinburgh, also, among other medicated pessaries, recommends one of tannic acid, made by incorporating ten grains of the acid with a sufficient quantity of *cacao butter*. (*Ed. Med. Journ.*, May, 1865, p. 1042.)

The British Pharmacopœia directs *suppositories of tannic acid*, made by mixing the acid with lard, wax, and glycerin; each suppository weighing twenty grains, and containing two grains of tannic acid. A better excipient, however, would be the cacao butter. The remedy may be used in prolapsus ani, piles, and anal leucorrhœa.

Tannic acid in solution is one of the substances which has been recently used in the form of spray, by means of the atomizer. It has been employed in œdema of the glottis, laryngeal ulcerations and excrescences, and in chronic bronchitis. The strength of the solution for these purposes varies from one to twenty grains to the fluidounce of water. A stronger solution, containing thirty grains to the fluidounce, has been used in hæmoptysis. (Da Costa, *N. Y. Med. Journ.*, Oct. 1866, p. 35.)

2. GALLIC ACID.—ACIDUM GALLICUM. *U. S.*, *Br.*

Origin. Gallic acid is procured from galls, either through the gallic acid fermentation which these undergo when exposed, in the state of powder, to water and atmospheric air, or through the reagency of sulphuric acid.

Sensible and Chemical Properties. The acid is in delicate, silky, acicular crystals, colourless when quite pure, somewhat brownish as commonly kept in the shops, inodorous, of an acidulous slightly astringent taste, sparingly soluble in cold, but freely in hot water, very soluble in alcohol, and slightly soluble in ether. It produces a deep bluish-black colour with solutions of the salts of sesquioxide of iron, but has no effect on that of sulphate of the protoxide, and differs from tannic acid in not causing precipitates with gelatin, albumen, or salts of the organic alkalies.

Effects on the System. In small doses, gallic acid produces no sensible effect when swallowed, and, in the largest ever given for medical purposes, is said to occasion only a feeling of internal heat. Externally applied, it produces little of the corrugating effects characteristic of the astringents.

Therapeutic Application. This substance has but recently been employed as a medicine. Formerly supposed to be the active principle of the vegetable astringents, though not used in the isolated state, it lost this reputation almost entirely upon the discovery of the much greater astringency of tannic acid; and it is only within a few years, that it has partially recovered its original credit.

There can be no doubt of its great inferiority to tannic acid in affections of the skin, alimentary canal, and all those parts with which the medicine can be brought into direct contact. But, not having those chemical relations which render the absorption of tannic acid as such impossible, it may enter the circulation, and thus reach all parts of the system; and, as tannic acid may possibly be converted into gallic acid before being absorbed, and through this agent produce all its general effects upon the system at large, the inference is not unreasonable, that the latter medicine might, perhaps, be substituted for the former, without disadvantage, in all cases in which the effects are to be produced through admixture with the blood. We might go further, and calculate upon results even more favourable from the gallic than the tannic acid; as, independently of its more ready entrance into the circulation, it is less apt to disturb the stomach and constipate the bowels, and thus to interfere with digestion. Experience, however, upon these points is not yet settled; and, though gallic acid has been of late much employed, very different opinions have been given of its powers. These remarks on the relative efficiency of gallic and tannic acids, have reference only to the latter acid as it is procured from galls.

The complaints in which gallic acid may be most advantageously given are the hemorrhages, and especially those proceeding from parts which are conveniently accessible only through the circulation, as *hæmoptysis*, *hæmaturia*, and *menorrhagia* or *uterine hemorrhage*. In the last-mentioned affection it is thought to have proved peculiarly efficacious; and in hæmaturia it might reasonably be expected to be so, as it passes out of the system through the kidneys. In all these complaints, it has the great advantage of being quite destitute of irritant or general stimulant properties, at least in medicinal doses, and it is not improbable that it is somewhat sedative to the circulation, or refrigerant, like many other vegetable acids. The power has been claimed for it of arresting, in some degree, the escape of albumen from the blood in cases of *albuminous urine;* and it has been employed with supposed benefit in *simple diuresis*, and in *chronic mucous discharges from the urinary organs.* It has been found, moreover, one of the most effective remedies in cases of *chylo-serous* or *spontaneously coagulable urine.*

The dose is from five to twenty grains three times a day. It may be given in the form of pill, made with conserve of roses, or with syrup and powdered gum arabic; in the form of powder; or in liquid mixture.

II. OAK BARK.

WHITE-OAK BARK.—QUERCUS ALBA. *U. S.*

BLACK-OAK BARK.—QUERCUS TINCTORIA. *U. S.*

QUERCUS. *Quercus pedunculata. Br.*

The bark of most of the oaks is possessed of properties very nearly identical, so that one species may generally be substituted for another without great disadvantage. *Q. Robur* and *Q. pedunculata*, the latter of which is the common British oak, are the species most used in Europe; *Q. alba* or American white-oak, *Q. prinus* or white chestnut-oak, *Q. montana* or rock chestnut-oak, *Q. falcata* or Spanish oak, and other indigenous species, have been indifferently used in this country. Our Pharmacopœia has adopted *Q. alba* or white-oak, as the representative of the oaks in general, being one of the most astringent, and *Q. tinctoria* or black-oak, as possessing somewhat different properties, and requiring a separate consideration. It is the inner bark, in all the species, which is principally efficacious; and this, therefore, should be employed to the exclusion of the epidermis, when the latter is readily separable. The bark is better from the young branches than the old, and gathered in the spring than at other seasons.

Sensible Properties. The inner bark has a coarse, fibrous texture; a light-brownish or reddish-brown colour; a slight peculiar odour, little perceptible in single pieces, but very obvious in mass; and a rough, astringent, bitterish taste.

Active Principles. These are *tannic acid* of the kind found in galls, *gallic acid*, and a bitter crystallizable, neuter substance, called *quercin*, which has been found in the bark of European oaks, and probably exists in most or all of the species. Of these principles, tannic acid is the most abundant and most important. They are all extracted by water and alcohol.

Incompatibles. These are the same essentially as those of galls; but the bark of the British oak is said not to precipitate tartar emetic.

Peculiarities of Q. tinctoria, or Black-oak Bark. This variety is more bitter than most of the others, and differs also in staining the saliva yellow when chewed. Besides the tannic and gallic acids, it contains a peculiar colouring principle, called *quercitrin*, which renders it valuable as a dye-stuff, in which capacity the coarsely powdered bark is considerably used under the name of *quercitron*.

Effects on the System. The effects of oak bark are those of a mild astringent and tonic. Experiments performed with it at the veterinary school of Lyons appear to show that, when largely taken, it renders the blood redder, thicker, and more viscid, and at the same time diminishes the putrefactive tendency after death. The blood of a horse, which was made to take twenty pounds of the bark in a month, was said, at the end of that time, to have undergone the change referred to; and the body of the animal, which was killed, remained two months without the least sign of putrefaction.

Black-oak Bark is said to differ from the other varieties in having some tendency to operate on the bowels.

Therapeutic Application. Oak bark has been used *internally* in *chronic diarrhœa* and *dysentery*, in *passive hemorrhage from the bowels*, and in *intermittent fever;* but it is little employed in this way. The inhalation of the odorous matter which exhales from large quantities in mass, has been thought to be advantageous in *phthisis;* because this disease has been observed to prevail less among tanners than with other classes of people; but more accurate and copious statistical details are wanted to establish the fact. The black-oak bark, in consequence of its supposed irritant effects on the bowels, should not be given in cases of diarrhœa.

The *topical* use of the bark is much greater than the internal. The decoction has been employed as a bath, especially for children, in *marasmus, scrofula, chronic diarrhœa, cholera infantum*, and *intermittent fever*. It has also been found useful as a gargle in *prolapsus of the uvula* and *inflammation of the fauces;* as an injection in *leucorrhœa, prolapsus uteri, prolapsus ani*, and *dropsical cysts;* and as a wash, or in the form of poultice, in *piles, old and obstinate ulcers, edematous swellings of the limbs and joints*, and even in the cure of *reducible hernias*, aided by the use of a truss. The powder made into a cataplasm is said to have been useful in *external gangrene;* and the infusion taken from tanners' vats has been beneficially employed in *old, flabby*, and *ill-conditioned ulcers.*

Administration. The dose is from thirty grains to a drachm. An extract made by boiling the decoction to dryness has been given in half the quantity. The decoction (DECOCTUM QUERCÛS ALBÆ, *U. S.*), made in the proportion of an ounce to a pint of water, is given in the dose of two fluidounces. In each instance, the dose may be repeated from three to six times in a day. For external use, the decoction may be made with twice the proportion of bark just mentioned.

The *fruit* of the oak, or *acorn*, is more astringent and bitter than the bark, and has been considerably used in scrofulous affections. It is said to be more efficacious when previously roasted, in consequence of a supposed beneficial influence of the resulting empyreumatic products upon the nervous system. The most agreeable form for use is that of an infusion or decoction, prepared from the roasted and ground fruit, exactly in the manner of coffee, and taken like that with sugar and cream.

For an adult, half an ounce of acorns may thus be prepared for each morning and evening meal; for a child, from half a drachm to a drachm, with a convenient quantity of water.

Acorns have been sometimes used as food in periods of famine; but they are said to produce for a time obstinate constipation, followed in the end by diarrhœa and cholera.

* * *

III. KINO. *U.S., Br.*

The name of kino was first conferred upon an astringent product, introduced into use by Dr. Fothergill of London, about the middle of the last century, and supposed to have been the concrete juice of *Pterocarpus erinaceus*, a tree growing on the western coast of Africa. But the same name has since been extended to similar products from other sources, and may now be considered as a generic title for various concrete juices, of a reddish-brown or blackish colour and astringent taste, and existing either in the state of minute, shining, angular fragments, or of larger masses very readily breaking into such fragments. The varieties now in use are the *East India kino*, the *West India or Jamaica kino*, and the *South American or Caracas kino.* The East India variety is most employed.

1. East India Kino is the inspissated juice of *Pterocarpus Marsupium*, a large tree growing in the mountains upon the Malabar coast of Hindostan. It is in small, irregular, angular, brittle, glistening fragments, of a dark reddish-brown almost black colour, redder and lighter in powder, inodorous, of a bitterish strongly astringent taste followed by a sense of sweetness, softening in the mouth when chewed, adhering somewhat to the teeth, and staining the saliva blood-red. Water and alcohol dissolve all its active matter, receiving from it a deep-red colour.

Its *active principle* is tannic acid, of the variety called *kino-tannic acid*, which precipitates the salts of sesquioxide of iron of a greenish or olive-black colour. This differs, moreover, from the tannic acid of galls, in being converted, by exposure to the atmospheric air, into a brick-red, tasteless, and inert matter, instead of into gallic acid. Besides this principle, there is also *extractive matter*, upon which possibly the bitterness may depend.

Its *chemical reactions* are the same with those of the tannic acid of galls, except that the alkalies favour its solubility in water, while they destroy its astringency.

2. West India, or Jamaica Kino, is said to be an extract of the wood and bark of *Coccoloba uvifera*, growing in the West Indies; but this origin is somewhat doubtful; and specimens which I have seen

under that name, had the appearance of an inspissated juice, and probably were so; as, on chemical examination, they were found to contain a resinous ingredient.

In *sensible properties*, in the characters of its *active principle*, in *solubility*, and general *chemical reactions*, it is not materially different from the preceding variety; except that, instead of being imported in minute fragments, it has been brought to this country in a compact mass in gourds, and breaks into rather larger and more rectangular fragments, less glistening, and not quite so dark.

3. SOUTH AMERICAN, or CARACAS KINO, is brought from the northern coast of South America; but its botanical source is unknown. It is in large irregular masses, which, after importation, are broken up into small irregular fragments, less sharply angular, glistening, and dark-coloured than the E. India variety, and in these respects closely resembling that from the W. Indies. In taste and smell, solubility, the character of its active principle, and in general chemical relations, it resembles the preceding variety.

Besides these varieties of kino, there is the *Botany Bay kino*, from *Eucalyptus resinifera* of New South Wales, and a product named *Butea gum*, from *Butea frondosa* of Hindostan, both of which have the general properties of this drug, but are little used in the United States. (See *U. S. Dispensatory*.)

Effects on the System. So far as they have been investigated, the effects of kino are not essentially different from those of galls; but it is doubtful whether they exert an equal influence through the circulation; as their tannic acid is not capable, like that of galls and oak bark, of being converted into absorbable gallic acid, but passes, through the reagency of oxygen, into the state of a tasteless, insoluble, and inert matter.

Therapeutic Application. Kino is one of the best of the vegetable astringents for internal use, on account of its purity, and general acceptability to the stomach. It is employed chiefly in diseases of the alimentary canal; and, though occasionally prescribed internally for hæmoptysis, menorrhagia, and leucorrhœa, it probably, for reasons already given, exerts little influence in these complaints. In those forms of *diarrhœa* and *advanced or chronic dysentery*, in which astringents are indicated, it is a very useful remedy, and much employed in this country. It may also be sometimes used advantageously in *epidemic cholera*, in order to check the excessive evacuations. *Pyrosis*, *hæmatemesis*, and *intestinal hemorrhage* are among the complaints in which good effects may be expected from it. In the last-mentioned affection, occurring in the advanced stages of low fevers, it is an admirable remedy. I have seen it promptly check the most alarming hemorrhage attendant on enteric or typhoid fever; but it must be given very freely, much more so than under ordinary circumstances. In all these complaints it should generally be associated with opium.

Locally, in the form of powder, it is sometimes efficacious in arresting hemorrhage from bleeding surfaces. In a bloody tumour of the roof of the mouth, which bled alarmingly upon being cut into, I once succeeded in checking the hemorrhage, after trying other means unsuccessfully, by filling the incision with the powder, and causing a piece of patent lint, on which the powder was thickly sprinkled, to be pressed firmly by the tongue against the tumour. In the same form, it may sometimes be sprinkled beneficially upon the surface of flabby ulcers. In the form of infusion also it is sometimes topically applied, as in cases of *epistaxis, relaxation of the uvula, aphthæ, leucorrhœa,* and *obstinate gonorrhœa;* but its liability to stain everything which it touches is some objection to this mode of employment.

Administration. The dose is from five to thirty grains, which may be repeated every two, three, or four hours in cases of urgency, and three or four times a day in the more chronic. In bowel complaints, it is frequently associated with prepared chalk or oyster shell, and one of the liquid preparations of opium, in the form of mixture, made by suspending the insoluble ingredients in some aromatic water, by means of gum arabic and loaf sugar.

In the form of pill, kino may be given, combined with acetate of lead and opium, in cholera and diarrhœa. Though the salt of lead is probably decomposed by the tannic acid, experience has proved the efficacy of the combination.

Kino may also be prescribed in the form of an electuary, made by mixing the powder with syrup or molasses; and powdered cinnamon, powdered opium, and prepared chalk, one or all, may be added as circumstances may seem to require.

A more elegant preparation is an *infusion*, made in the proportion of two drachms of kino and a drachm of powdered cinnamon to eight fluidounces of boiling water, and filtered when cold. Of this one or two tablespoonfuls may be given for a dose, sweetened with loaf sugar, and mixed, in cases of diarrhœa, with a fluidrachm of camphorated tincture of opium, or an equivalent quantity of some other liquid preparation of that narcotic. If the effects of chalk are required, this antacid may be mixed with the infusion by the intervention of powdered gum and sugar.

Tincture of Kino (TINCTURA KINO, *U. S.*) is an officinal preparation, and, in cases where the alcoholic menstruum is not objectionable, may be given, in the dose of one or two fluidrachms, added to cretaceous mixtures, or other liquid astringent preparation. It should, however, be used recently made; as it is apt to gelatinize by time, and to lose its astringency.

IV. CATECHU. *U.S.*

CATECHU NIGRUM. *Black Catechu.* Acacia Catechu. *Br.*

Origin and Properties. Catechu is an extract prepared from the inner wood of *Acacia Catechu*, a small tree growing in Hindostan, Pegu, and other parts of India. It is in masses or fragments of diversified shape and size, usually rusty-coloured externally, reddish-brown internally, with a fracture generally smooth and somewhat shining but sometimes rough, inodorous, and of a bitterish very astringent taste, with a sweetish after-taste. It yields its virtues to water and alcohol.

Active Principle. This is *tannic acid*, of the variety which yields with the salts of sesquioxide of iron a greenish-black or olive-black precipitate, and may be called *catechu-tannic acid.* Another constituent, to which it probably owes its sweetness, is *catechuic acid*, which, however, is not known to possess any medical virtues.

Its *chemical relations* are the same as those of kino.

Effects on the System. So far as the effects of catechu upon the system can be traced, they are almost precisely those of the medicine last described.

Therapeutic Application. Its therapeutic uses are almost the same as those of kino, and need not, therefore, be repeated here. It is, however, I believe, less used internally in this country, probably because less elegant in appearance, and usually less pure. Some writers speak of it as specially advantageous in checking excessive expectoration; but I cannot think that it has much power of this kind. As a topical application, in the form of infusion, it has the advantage over kino of staining less. From its greater hardness, it is better adapted to the treatment of *chronic angina*, with *relaxation or elongation of the uvula*, in which it sometimes proves very useful by being held in the mouth between the cheek and teeth, and allowed slowly to dissolve. Its solution in the saliva is thus brought constantly, as it is swallowed, into contact with the diseased parts, and keeps up a steady astringent action upon them. In the same way it is said to be used by professional singers and speakers, to relieve the hoarseness consequent on an excessive use of the voice. In the form of powder, it is also occasionally useful in *spongy gums*, to which it may be applied by means of a camel's-hair pencil. The tincture is preferable to that of kino, in consequence of being less liable to change by keeping.

The dose of the powder is from ten to thirty grains, that of the *officinal Tincture* (TINCTURA CATECHU, *U. S.*), from thirty minims to three fluidrachms. An infusion (INFUSUM CATECHU COMPOSITUM) is directed both by the U. S. and British Pharmacopœias, made, according to the former, with half an ounce of catechu and a drachm of cinnamon to a pint of boiling water. The dose is one or two fluidounces three or four times daily. The modes of administration, not specially noticed, are precisely the same as those already sufficiently described under kino.

GAMBIR.

Catechu Pallidum. *Pale Catechu.* Uncaria Gambir (Nauclea Gambir). *Br.*

This is probably the old *terra Japonica.* It is usually ranked with the varieties of catechu, which it closely resembles in virtues; but it has a wholly different origin, being an extract from the leaves and young shoots of *Nauclea Gambir* (*Uncaria Gambir*, De Candolle), which is a native of Eastern India. It is in the form of cubes, of about an inch in size, light and porous, of a yellowish or reddish-brown colour, lighter within, an earthy fracture, and a strongly astringent, bitter, and sweetish taste. It is closely analogous in composition to catechu, and may be used for the same purposes, and in the same dose.

V. RHATANY.

KRAMERIA. *U. S., Br.*

Origin and Properties. Rhatany is the root of *Krameria triandra*, a shrub growing in Peru. It is usually in long, cylindrical pieces, from the size of a straw, to half an inch or more in diameter, sometimes in the form of radicles attached to a short, thick, common head. The root consists of a reddish-brown bark, in which the virtues chiefly reside, and of an interior lighter-coloured, but still reddish ligneous portion. It yields a reddish powder, is inodorous, but of a slight peculiar smell in decoction, and has a bitter, very astringent, and slightly sweetish taste. Its virtues are extracted by water and alcohol, but are impaired by boiling. The infusion and tincture are reddish-brown.

Active Constituents. Its chief active principle is a variety of *tannic acid*, somewhat peculiar in properties, affording a deep grayish-brown precipitate with the salts of sesquioxide of iron, and converted by oxidation, especially at an elevated temperature, into an inert apotheme. It contains, also, *bitter extractive*, which may have tonic virtues; and a peculiar acid called *krameric*, for which some influence over the system has been claimed, but of which little is known.

Its *chemical reactions* are the same essentially as those of the other vegetable astringents in general.

Effects on the System. Rhatany combines the effects of a powerful astringent with those of a gentle tonic, and does not, in these respects, differ observably from kino and catechu. Like these, also, it may operate less forcibly, through the route of the circulation, than the tannic acid of galls or the astringents containing it; because its active principle, instead of being converted by oxidation into gallic acid, which is at once absorbable and astringent, becomes under that process an insoluble and inert apotheme. But this view of its action on the system must be considered as somewhat theoretical.

Therapeutic Application. Rhatany has been employed for all the purposes of the vegetable astringents generally, and may be considered as identical in its therapeutic application, both internal and external or topical, with kino and catechu. To mention, therefore, in this place, the several affections for which it has been recommended would be mere repetition. There is one use of it, however, which requires special notice; as, though there can be little doubt that either of the astringents just mentioned would answer the same purpose, yet they have not been put so fully as rhatany to the test of experiment. The use referred to is in the cure of that most painful and obstinate affection, known by the name of *fissure of the anus.* M. Bretonneau found injections of krameria an almost certain remedy in that complaint; and his experience has been confirmed by that of M. Trousseau. The injection employed by him consisted of a drachm and a half of the extract of rhatany, dissolved in five fluidounces of water, to which about a fluidrachm of the tincture of rhatany was added. This was administered daily, the rectum having been previously cleared out by an enema of warm water, or some mucilaginous fluid The patient usually experienced relief in the course of a week, and was effectually cured in two or three weeks. In the use of the remedy, the pains are at first sometimes aggravated; but this should not prevent a perseverance with it. Great care must be taken, after the cure, to keep the evacuations, by means of laxatives if necessary, in a soft state, so as to prevent a reproduction of the fissures. MM. Trousseau and Blache have employed the same remedy, with great benefit, in the treatment of fissures and excoriations of the nipple in nursing women. They first wash the part with a liquid consisting of 5 parts of the extract, 10 of the tincture, and 100 of water, and then introduce into the fissures the extract brought into a proper consistence by means of the white of eggs.

Administration. The dose of the powdered root might be from a scruple to a drachm; but the medicine is seldom used in this form. The most elegant preparation, and one of the most useful of all the vegetable astringents, is the officinal *Extract* (EXTRACTUM KRAMERIÆ, *U. S.*), prepared according to the directions of our national code. The dose of it is from ten to twenty grains. The *Tincture of Rhatany* (TINCTURA KRAMERIÆ, *U. S.*), and *Syrup of Rhatany* (SYRUPUS KRAMERIÆ, *U. S.*), are also officinal preparations, the former of which is given in the dose of one or two fluidrachms, and the latter, which is especially adapted for children, in that of half a fluidounce for an adult, and twenty or thirty minims for a child a year or two old.

VI. LOGWOOD.

HÆMATOXYLON. *U. S.*—HÆMATOXYLUM. *Br.*

Origin. This is the inner or heart-wood of *Hæmatoxylon Campechianum*, a tree of medium size, growing in Campeachy and on the shores of the Bay of Honduras, in the Peninsula of Yucatan, and in Jamaica and other West India islands, into which it is said to have been introduced from the Continent.

Sensible Properties. It comes in billets of various magnitude, hard, compact, and heavy, of a red or yellowish-red colour, becoming darker and almost black by exposure, of a peculiar not disagreeable odour, and a sweet somewhat astringent taste. As kept in the shops for use, it is in small chips, or in the form of a coarse powder produced by rasping. It yields its virtues, with a deep purplish red colour, to water and alcohol.

Active Principles. Its chief constituents are a variety of *tannic acid* in small proportion, in which its astringency resides, and a peculiar colouring principle called *hæmatoxylin*, to which it owes its colouring properties and sweetness.

Chemical Reactions. The decoction of logwood produces precipitates with lime-water, acetate of lead, and alum, a deep-violet blue with the salts of sesquioxide of iron, and reddish curdy flakes with a solution of gelatin.

Effects on the System. The effects of logwood on the system are those of a pure mild astringent, without bitterness, and without irritant properties. The colouring principle appears to be absorbed, as the urine is reddened by the internal use of the medicine.

Therapeutic Application. This astringent is applicable to *mild cases of diarrhœa and chronic dysentery*, in which simple astringency is required, and more irritating substances might be injurious. It is especially suited to the diarrhœa of children, and has been considerably employed in that form of it which succeeds cholera infantum, after the violence of the disease has been subdued. It may be used also for the general purposes of the vegetable astringents, but is too feeble for much effect, unless in cases of the kind above referred to.

Administration. The only two forms in which it is used are those of the *Decoction* (DECOCTUM HÆMATOXYLI, *U. S.*) and *Extract* (EXTRACTUM HÆMATOXYLI, *U. S.*), both of which are officinal. In the former U. S. Pharmacopœia, the process of which I prefer, the decoction was prepared by boiling an ounce of the rasped wood with two pints of water to a pint; and two drachms of bruised cinnamon might sometimes be usefully added at the end of the boiling. The dose is two or three fluidounces for an adult, two or three fluidrachms for a child of two years, to be repeated three or four times a day, or more frequently if required. The dose of the extract is from ten to thirty grains. It may be given in the form of pill or solution; but, if pills are preferred, they should be taken freshly prepared; as they are said to become so hard, by long keeping, as sometimes to pass through the bowels unchanged.

◆

VII. CRANESBILL.

GERANIUM. *U.S.*

Origin and Properties. This name has been given to the root, or rather rhizome of *Geranium maculatum*, a small, herbaceous, perennial plant, growing in woods throughout the United States. It is in pieces from one to three inches long, somewhat flattened, wrinkled, tuberculated, compact, externally brown, internally reddish-gray, inodorous, and of a pure astringent taste, without bitterness, or other disagreeable quality.

Active Principle. This is *tannic acid*, having the general properties of that principle, but of what precise character is yet undetermined; though if it be true, as stated by some, that the root contains also *gallic acid*, it must be of the kind found in galls. From a recent analysis of the root by the Messrs. Tilden, who recognized the presence both of tannic and gallic acids, it may be inferred that these are its only active constituents.

Effects and Uses. Cranesbill has the effects on the system of an efficient and pure astringent. From its want of unpleasant taste, it is particularly suited to infants, and persons of delicate palate and stomach. It may be used for all the purposes of the vegetable astringents already detailed, whether external or internal; but has been most highly recommended, as an internal remedy, in *chronic diarrhœa and dysentery*, and, as a topical application, in cases of *aphthous ulceration of the mouth and fauces.* It is peculiarly applicable to the looseness of bowels following cholera infantum, in consequence of its exemption from irritant properties.

Administration. The dose of the powdered root is from twenty to thirty grains. It is, however, more frequently given in the form of decoction, which may be prepared by boiling an ounce of the bruised root in a pint and a half of water to a pint, and given in the dose of one or two fluidounces, repeated three or four times a day. For infants the decoction in milk, in the proportion of an ounce to a pint, is an eligible preparation, and may be given to a child a year or two old in the dose of one or two fluidrachms, or more largely if required. An extract and tincture have been recommended, but are little used.

VIII. BLACKBERRY ROOT.

RUBUS. *U.S.*

Origin. Under this name the present U. S. Pharmacopœia unites the roots of the *Rubus villosus* or common blackberry, and the *Rubus Canadensis* (*R. trivialis,* Pursh) or dewberry; and, as there is no known difference in effects between them, they have been very properly consolidated, instead of being designated, as in the old Pharmacopœia, by distinct officinal titles. These two species of Rubus are indigenous briers, growing in different parts of the United States.

Properties. The roots are cylindrical or branching, with a brown or ash-coloured bark, and a central woody portion, the former of which is of a bitter and strongly astringent taste, the latter is tasteless, and both are without smell. The woody part is inert; and either the smaller roots, or the bark only of the larger, should be employed. Water and alcohol extract all their virtues.

Active Principles. These are *tannic acid,* and probably a *peculiar bitter principle,* which, however, has not yet been isolated.

Effects on the System. There is no observable difference in the effects of these roots. Both are gentle tonics, and energetic astringents.

Therapeutic Application. Blackberry and dewberry root may be employed for the same purposes generally as the bitter vegetable astringents; but are seldom given except for bowel complaints, in which they are highly esteemed popular remedies. I have used them in *diarrhœa* with advantage. They are applicable only to chronic cases of this disease, or to such as are connected with intestinal debility; and should not be employed when there is general fever, or any acute inflammation of the mucous membrane of the bowels. They are a favourite domestic remedy in the diarrhœa which follows cholera infantum.

Administration. They are usually given in the form of decoction, made by boiling an ounce of the bruised roots in a pint and a half of water to a pint, and administered in the dose of a wineglassful for an adult, a dessert-spoonful for a child two years old, three or four times a day, or more frequently. It may be well to add to the decoction, at the end of the boiling, half an ounce of bruised orange peel, or two drachms of bruised cinnamon, in order to qualify the flavour, and render the preparation more acceptable to the stomach.

IX. UVA URSI. *U.S., Br.*

Origin and Properties. Uva ursi consists of the leaves of *Arctostaphylos Uva Ursi*, or *bearberry*, a low evergreen shrub, growing in the northern parts of Asia, Europe, and America, and extending in the United States as far south as New Jersey, where it is found abundantly. The leaves are from half an inch to an inch long, somewhat wedge-shaped, thick and coriaceous, with a smooth rounded margin; on the upper surface smooth, shining, and brownish-green, on the lower lighter coloured and reticulated; inodorous when fresh, of a hay-like smell when dried, and of a strongly astringent, bitterish, and ultimately sweetish taste. Water and officinal alcohol extract all their virtues.

Active Principles. These are *tannic acid* of the kind found in galls, *gallic acid*, *a bitter substance*, and, according to Mr. Hughes, a peculiar crystallizable principle called by him *ursin*, which he found diuretic in the dose of a grain. (*Am. Journ. of Pharm.*, xix. 90.) Two other crystallizable principles, denominated by their discoverers respectively *arbutin* and *ursone*, have been detected in the leaves; but, as they have not been proved to possess active properties, they cannot be considered of much importance. (See *U. S. Dispensatory.*)

The *incompatibilities* of uva ursi are essentially the same as those of galls.

Effects on the System. Uva ursi is astringent and gently tonic, with the property of slightly increasing the secretion of urine, and at the same time altering its colour. Its astringent principle is said to have been detected in the urine; but it was probably the gallic acid. In overdoses it is apt to produce nausea and vomiting.

Therapeutic Application. This medicine is probably capable of producing, in a greater or less degree, all the effects of the vegetable astringents, but is less powerful than most of those already described. Towards the close of the last, and at the beginning of the present century, it was very highly esteemed and much employed in various affections of the urinary and genital apparatus, and even acquired some reputation in *pulmonary consumption*, which, however, it soon lost. It was used in *chronic inflammation and ulceration of the kidneys*, *gravel*, *diabetes*, *cystirrhœa*, *strangury* and *bloody urine*, *paralysis of the bladder*, *incontinence of urine*, *leucorrhœa*, and *menorrhagia*; and was believed by many, if not to dissolve stone in the bladder, at least greatly to relieve the symptoms of that affection. That its virtues were overestimated there can be no doubt; but, in the natural reaction which has followed, it has appeared to me that the credit which it now enjoys is scarcely equal to its merits. The circumstance that it changes the character of the urine would seem to show, that some one or more of its constituents passes out with that fluid; and it is not improbable that it thus directly exercises an astringent, somewhat corroborant, and perhaps alterative effect upon the surface of the mucous membrane, lining the pelvis of the kidney, the ureter, and the bladder. Experience has, I think, shown that it possesses this power; and it is probably to this alone that it owes any peculiar therapeutic efficacy which it may possess. No one now believes that it is capable of materially modifying the symptoms of stone in the bladder, in any other way than by invigorating the kidneys when relaxed or debilitated, or by relieving the attendant inflammation of the urinary passages; and any efficacy which it may possess in gravel must be ascribed to the same cause. It should not be employed in acute inflammation of these organs, as its excitant property, under such circumstances, could prove only injurious; but in chronic affections, when the membrane is relaxed, when atonic ulceration may be suspected, and the urine is loaded with pus or mucus in excess, it may be used with great propriety, and with reasonable hope of advantage.

The complaints in which it has proved most efficacious, in my experience, are *chronic inflammation of the pelvis of the kidney with purulent impregnation of the urine*, and the similar affection of the bladder, known as catarrh of that organ, or *cystirrhœa*. In cases of this kind, persevered in for a long time continuously, for several months if necessary, I believe that it will occasionally effect cures even unaided, and will often prove a serviceable adjuvant to other measures. Though apparently indicated in atonic hæmaturia, I have not found it equally efficacious. It sometimes appears to do good in *spermatorrhœa*, probably by an invigorating effect upon the mucous membrane at the neck of the bladder, or origin of the urethra; and, by a similar influence, extended sympathetically to the sphincter, it is occasionally useful in *nocturnal incontinence*, though it must be confessed that it much more frequently fails.

Administration. The dose of the powdered leaves is from a scruple to a drachm; but the *Decoction* (DECOCTUM UVÆ URSI, *U. S.*), made in the proportion of an ounce of the leaves to a pint of water, is a more eligible preparation. It may be given in the dose of one or two fluidounces, three or four times daily. A *fluid extract* (EXTRACTUM UVÆ URSI FLUIDUM, *U. S.*) is directed by our officinal code, the dose of which is from thirty minims to a fluidrachm.

X. PIPSISSEWA.

CHIMAPHILA. *U. S.*

Origin and Properties. This consists of the leaves of *Chimaphila umbellata*, a low evergreen plant, growing in the northern parts of Asia, Europe, and America, and abundant in the United States. These leaves are about an inch and a half long, wedge-shaped, pointed at the end, notched on the border, coriaceous, shining and of a bright sap-green colour on the upper surface, paler beneath, of a peculiar odour when fresh and bruised, and of an astringent, bitterish, somewhat sweetish, and not disagreeable taste. Water and alcohol extract their virtues.

Active Principles. These are *tannic acid*, and *bitter extractive.* It is probable that the matter indicated by the latter title is really complex, and that among its constituents is a peculiar principle, upon which all the virtues of the medicine, not connected with its astringency, depend. A crystallizable principle was obtained from the leaves by Mr. Samuel Fairbank, and denominated by him *chimaphilin*, though its claims to this title are doubtful, as it is probably destitute of active properties. (See *U. S. Dispensatory*, 12th ed.)

Effects on the System. The fresh leaves, bruised and applied to the skin, are said to be rubefacient and even vesicating. Internally, they are mildly astringent and tonic, with the property of somewhat increasing the secretion of urine, to which they probably impart some degree of remediate power. It is, I think, scarcely doubtful that their peculiar active principle, through which they stimulate the kidneys, passes off, either changed or unchanged, with the urine.

Therapeutic Application. Pipsissewa was much employed by the aborigines of this country, to whom it owes the name by which it is now generally designated. It is sometimes called *wintergreen;* but, as this name has also been applied to *Gaultheria procumbens*, it should be abandoned for both. From the Indians the medicine passed into popular use, whence it was adopted by the profession. It was used chiefly in *scrofula, rheumatism*, and *affections of the kidneys and urinary passages.* Its diuretic powers have recommended it in *dropsy*, and it has been employed with asserted advantage in cases of this disease attended with debility; but little reliance can be placed upon its efficacy; and at best it should be used only as an adjuvant to other more powerful diuretics.

In *scrofula*, it is, I think, a valuable remedy. The late Dr. Joseph Parrish used it very extensively in this affection, and had great confidence in its powers. I have myself been in the habit of employing it, in cases of external scrofula, during the whole period of my practice, and have found few remedies which have appeared to me more efficacious

Its mildly astringent and tonic properties adapt it admirably to the treatment of the scrofulous cachexia, in which a general laxity of the tissues, and debility of the functions, call for these two remedial influences; while the chronic character of the affection requires that the medication should be gentle, in order that it may be long sustained, without injury to the organs. In the earlier stages of the disease, I have been in the habit of directing, in connection with its use, a saline laxative twice or three times a week, and in anemic cases have had recourse also to the chalybeates; but in many instances the pipsissewa has been the remedy mainly relied on. It has seemed to me to exercise a favourable alterative influence in scrofula, independently of its astringency and tonic power; but it is extremely difficult to discriminate, in affections of this kind, between the course of nature and the effects of remedies, so that it is proper to speak of the latter with some reserve. Fully aware of the necessity of this caution, I am still of opinion, as the result of considerable experience, that pipsissewa deserves to rank next to cod-liver oil, and the preparations of iodine and of iron, in the treatment of scrofula; and may often be usefully combined with one or more of these remedies. In order that its full effects may be obtained, it should be long continued, with interruptions now and then, should any considerable degree of fever supervene. In cases attended with ulcers of an indolent or flabby character, it may be used with advantage in decoction as a wash, at the same time that it is administered internally.

The resemblance in properties between pipsissewa and uva ursi would suggest the employment of the former also in complaints of the urinary organs; but I have had little experience with it in these affections, and cannot, therefore, speak with confidence of its utility, though it has been recommended by others.

Administration. The *Decoction* (DECOCTUM CHIMAPHILÆ, *U. S.*), prepared by boiling an ounce of the bruised leaves in a pint of water, for fifteen minutes, and then adding enough water to make a pint, is the most eligible form for administration, and may be taken in the dose of from two to four fluidounces four times a day. A pint may generally be taken by an adult in twenty-four hours without inconvenience. Some recommend the medicine as an ordinary drink in scrofula, in the form of beer, which may be made by fermenting together sugar, water, and the bruised leaves, with the addition of yeast. An extract has also been recommended, and may be given in the dose of twenty or thirty grains.

◆

The vegetable astringents above described are those probably most used in the United States, and are numerous enough to afford all desirable latitude of choice to the physician. There are, however, several others having similar virtues, and some not less efficient than the preceding, with a general notice of which I shall content myself, from the fear of needlessly embarrassing the memory of the student, referring him for a particular account of them to the United States Dispensatory.

1. **RED ROSE** (Rosa Gallica, *U.S.*, *Br.*) consists of the unexpanded petals of *Rosa Gallica*, a European species of the rose, occasionally cultivated in our gardens as an ornamental plant. They are used chiefly in preparing a *Confection* (Confectio Rosæ, *U. S.*), much employed as a vehicle for substances made into pill, and one of the ingredients of the officinal mercurial pill; and the *Compound Infusion of Roses* (Infusum Rosæ Compositum, *U. S.*), which consists of an infusion of the flowers made with the addition of a small proportion of sulphuric acid, and the virtues of which depend mainly on the latter ingredient. There is an officinal *Honey of Roses* (Mel Rosæ, *U.S.*), and a *Syrup* (Syrupus Rosæ Gallicæ, *U.S.*, *Br.*), both of which are used as agreeable additions to liquid astringent mixtures, such as mouth-washes and gargles, but have no great merit of their own.

2. **TORMENTIL** (Tormentilla, *U. S.*) is the root or rhizome of *Potentilla Tormentilla*, or *septfoil*, a European plant. This is a simple and powerful astringent, formerly much employed, but neglected since the general introduction of kino and rhatany into use.

3. **WATER AVENS**, the root of *Geum rivale*, indigenous in Europe and the United States, is tonic and powerfully astringent.

4. **HARDHACK** (Spiræa, *U. S.*) is the root of *Spiræa tomentosa*, an indigenous shrub, all parts of which are bitter and astringent, though the root only is officinally recognized.

5. **POMEGRANATE RIND** (Granati Fructûs Cortex, *U. S.*) is the rind of the fruit of *Punica Granatum*, or pomegranate tree, indigenous in the warmer latitudes of the old continent, and cultivated in the southern section of the United States. This is bitter and astringent, and is used chiefly as a gargle in sore-throat, in the form of decoction.

6. **BISTORT**, the root of *Polygonum Bistorta*, growing in Europe and Northern Asia, was formerly much more used than at present, and is now seldom imported. It is an efficient astringent.

7. **ALUM-ROOT** (Heuchera, *U. S.*) is the root of *Heuchera Americana*, an indigenous plant, very strongly astringent.

8. **MARSH ROSEMARY** (Statice, *U. S.*) is the root of *Statice Caroliniana*, an indigenous maritime plant. It is an active astringent, and is used to a considerable extent in some parts of the United States.

9. **PERSIMMON** (Diospyros, *U. S.*) is the unripe fruit of *Diospyros Virginiana*, an abundant indigenous tree. This fruit, though sweet and edible when quite mature, is in the unripe state exceedingly astringent, and may be beneficially employed whenever a simple vegetable astringent is indicated.

XI. ALUM.

ALUMEN. *U.S., Br.*

Origin. Alum is a double salt, composed, in the crystalline state, of one equivalent of sulphate of alumina, one of sulphate of potassa, and twenty-four of water; and denominated, chemically, *sulphate of alumina and potassa.* It is prepared either by the direct combination of its constituents, or by various processes from certain minerals called *alum ores,* containing ingredients, by the mutual reaction of which, under favourable circumstances, and with necessary additions, the salt is generated.

Sensible and Chemical Properties. The salt is in octohedral or more rarely cubic crystals, or, as it is usually found in commerce, in irregular crystalline masses or fragments, whitish and translucent, slightly efflorescent, inodorous, and of a strongly astringent, sweet, and acidulous taste. Exposed to heat, it first melts, then boils up, loses its water of crystallization, and becomes white and opaque, and readily reducible to powder. In this state it is called *burnt alum,* or, officinally, *Dried Alum* (ALUMEN EXSICCATUM, *U. S.*). By a strong heat it is quite decomposed. In the crystalline state, it is soluble in about eighteen parts of cold, and three-quarters of its own weight of boiling water; is entirely insoluble in absolute alcohol, and very nearly so in proof spirit. It has an acid reaction with vegetable colours.

Incompatibles. Alum is incompatible with alkalies and their carbonates, lime-water, magnesia and its carbonate, tartrate of potassa, phosphate of soda, and acetate and subacetate of lead, with all of which it produces precipitates. Those thrown down by the alkalies are dissolved by an excess of alkali. It also precipitates solutions of albumen, gelatin, and many of the vegetable astringents, and coagulates milk.

Effects on the System. When applied externally, or taken internally in such manner and quantity as not to excite irritation, alum acts, so far as can be observed, purely as an astringent, contracting the tissues, diminishing the caliber of the blood-vessels, and thus lessening the colour of the part, and diminishing secretion and exhalation. On the mucous membrane of the mouth and fauces its astringent effect is strong, and the impression which it leaves behind it durable. I have often observed that, when used as a gargle at bedtime, it so affects the tongue and palate that the sense of taste remains much blunted in the morning. Acting directly on the alimentary mucous membrane, it lessens the number and quantity of the stools.

There can be no doubt that, when taken internally, it exerts its peculiar action also on the whole system, though its general is much less powerful than its local operation. The probability is that it is absorbed, as alumina has been found in the urine and viscera of animals to which it has been administered; but in what state precisely it enters the circulation has not been determined. Its effects upon the system at large are more observable in disease than in health; but dryness of the throat and fauces, with thirst, has been noticed as one of the results of its internal use.

It is believed by some, and not, I think, without reason, to be somewhat refrigerant or sedative in its influence on the circulation.

Some ascribe the astringent effects of alum to its chemical reaction with the tissues. Considering how instantaneous and considerable is the shrinking of the mucous membrane of the mouth, when a strong solution is applied to it, I cannot conceive that the result is owing to a mere chemical change. Not only in this case, but in every other, I believe that it operates by calling the vital property of contractility into action.

When used either outwardly or inwardly in large quantities, though primarily astringent, it becomes irritant after a time, and at length, if continued, may excite inflammation. This effect will follow the application even of small quantities to a very delicate or unprotected surface, as to the conjunctiva of the eye, or to the skin recently denuded of the epidermis. In such cases, its peculiar astringent effect is overwhelmed by the inflammatory action. Thus, when swallowed in the quantity of a drachm or more, it not unfrequently causes nausea and vomiting, and sometimes produces griping pains and purging. Devergie found about six drachms of dried alum, given to a dog, to produce death when the œsophagus was tied, so as to prevent vomiting. Under such circumstances, the mucous membrane of the stomach and bowels has been observed to be much inflamed. The same quantity, when the œsophagus is not tied, is discharged by vomiting without any permanent evil effects. Orfila found that seven drachms of powdered crystallized alum produced vomiting in dogs in from ten to thirty minutes. Dried alum, applied to a denuded surface, acts as a mild caustic, and is sometimes used with reference to this effect.

When used for a considerable time, in doses insufficient to nauseate, alum not unfrequently produces a sense of stricture in the epigastrium, precordial oppression, and other dyspeptic feelings, probably by interfering with the secretion of the gastric juice, and thus impairing digestion.

Therapeutic Application. Alum is useful, as an internal remedy, in those forms and states of *diarrhœa* and *chronic dysentery* to which astringents are applicable, and in *hemorrhage from the bowels* under similar circumstances. It is not so well adapted to *hemorrhage of the stomach*, in consequence of its liability to produce nausea and vomiting; but might nevertheless be employed in this affection, in considerable doses, should other remedies fail, and the case be urgent. In the treatment of the bowel affections, it has not unfrequently been associated with some of the vegetable astringents, such as tannic acid, kino, extract of rhatany, etc.; and, though it undergoes chemical change through reaction with these substances, yet it does not follow that the resulting products are inert; and experience has shown that the combination is often effectual. In the dose of ten or twelve grains three or four times a day, with an equal quantity of bitartrate of potassa, it has been found by Sir James Murray very useful in the chronic gastric affection, characterized by *vomiting of glairy mucus.*

In comparing the remedial efficacy of alum with that of the vegetable astringents, it will probably be found to be relatively more efficacious, when operating through the medium of the circulation, than directly upon the stomach and bowels. It is, indeed, sometimes given very advantageously in *menorrhagia* or *uterine hemorrhage*, and in cases of *bloody urine.* In obstinate hæmaturia connected with disease of the kidneys, I have known it apparently to produce the happiest results, after vain trials of other methods. There would seem to be no reason why it should not also prove serviceable in *hæmoptysis;* but it is less used in that affection; and I have myself so seldom employed it, that I should not be justified in giving an opinion, upon the ground of experience.

In all the above affections, alum may be used in combination with small doses of opium, which generally co-operates to the same result, and may also serve to obviate, in some measure, its tendency to irritate the stomach. For the latter purpose, one of the aromatics is also not unfrequently conjoined with it, as nutmeg or cinnamon, especially when it is given in powder.

With reference to its astringent property, alum has also been given in *dilatation of the heart*, and *aneurism of the aorta*, and sometimes, it has been thought, with advantage. *Incontinence of urine* from debility of the sphincter muscle of the bladder, *spermatorrhœa, obstinate leucorrhœa, colliquative sweating*, and *diuresis*, are other complaints in which it has been used with supposed benefit, and in which it would seem to be indicated. Little good can be expected from it in proper diabetes, in which it has, nevertheless, been recommended.

It was formerly supposed to possess febrifuge properties; and Cullen states that he succeeded with it in *intermittent fever*, given in connection with nutmeg, in anticipation of the paroxysm. But it is not to be relied on, and is not now employed in that disease.

Of much greater importance is it as a remedy in *colica pictonum* or *lead colic.* So long ago as the middle of the last century, it was employed in that affection by Grashius, a physician of Holland, and afterwards by Dr. Thomas Percival of England; but it did not attract particular attention until, at a comparatively recent period, it was brought into notice by M. Kapeler, physician to one of the hospitals of Paris. Since that time, it has been extensively used, and experience has pronounced decidedly in its favour. I have myself employed it with the best results, even where the opiate and mercurial treatment had failed. Its mode of operating is quite unknown. Some suppose that it cures the disease by converting the poisonous preparation of lead, which may have caused it, into the insoluble and inert sulphate of that metal. But it is by no means always that lead-colic proceeds from a preparation of that metal swallowed. Quite as often, probably, it originates through the inhalation of the fumes of the metal, or of vapours impregnated with one of its salts; and there is in such cases no poison in the bowels to neutralize. Besides, even when the poison has been swallowed, it probably acts much more through absorption into the blood than by mere contact with the membrane. If alum, therefore, act merely as a chemical antidote, it must do so by entering into the circulation, and there producing the insoluble sulphate, which, in this position, would probably produce as much mischief mechanically as the poison had done physiologically. But, independently of these considerations, it is a sufficient refutation of the notion of the chemical action of alum, that the same curative effect is not obtained from Epsom or Glauber's salt, or other soluble sulphate, or from sulphuric acid itself, which ought to be equally efficacious, if the chemical theory were true. All that we can say on the subject, in the present state of our knowledge, is that, though alum and lead are both astringent, yet each has its own specific or peculiar mode of action, and that the influence of the former is incompatible with that of the latter: in other words, alum cures the poison of lead on the principle, already sufficiently discussed, of *supersession*. (See page 51.)

The remedy is asserted to have been found effectual in other forms of colic; and it may be employed, with hope of special benefit, in those cases of *intestinal neuralgia* which are occasionally met with, bearing a close resemblance in their symptoms to colica pictonum. In this disease, alum is given in doses larger than are thought appropriate to most other cases in which it is used. From a scruple to a drachm or more may be administered every three or four hours, dissolved in some mucilaginous liquid, to which sulphate of morphia may be very advantageously added, in such quantities as may be necessary to allay the sufferings of the patient.

Alum has been recommended in *hooping-cough* by Dr. Davies, editor of Underwood's treatise on the diseases of children.

As an emetic, it has been advantageously employed in the treatment of *pseudomembranous croup*, by the two Drs. Meigs, father and son, of Philadelphia. A teaspoonful of the powdered salt is given to the child every ten or fifteen minutes until it vomits. A second dose is seldom required to produce the effect.

But it is *topically* that alum is most used. In arresting morbid discharges, it is among the most effectual of the local remedies in our possession. *Epistaxis* very rarely fails to yield to a solution of the salt, containing fifteen or twenty grains to the fluidounce, injected up the nostril. When the bleeding proceeds from a readily accessible part of the membrane, the solution may be applied by means of a piece of lint. In peculiarly obstinate cases, it has been recommeded to snuff or blow up the powder; but the method is I believe less effective, as the remedy cannot be in this manner so thoroughly applied to the whole surface.

The same solution is scarcely less effectual in the *hemorrhoidal flux*, and in hemorrhage proceeding from a point higher up the rectum. Three or four fluidounces of it should be injected at once, along with two or three fluidrachms of the solution of sulphate of morphia, of the U. S. Pharmacopœia.

It may also be used in *hemorrhage from the mouth or throat*, and to arrest *bleeding from leech-bites*. The latter is often extremely obstinate, and has even proved fatal. A method I have long used, with uniform success, is to make a saturated solution of alum in hot water, to impregnate a dossil of raw cotton with this before it begins to crystallize on cooling, and then to press the cotton upon the bite. In this way the salt is applied more effectually than it can be by any other method; as the saturated hot solution is vastly stronger than the cold, and still retains the alum, at a temperature at which it may be well tolerated by the skin. It is even better than the powder itself, which acts probably only so far as it is dissolved, and is less soluble in the blood than it is in hot water. The same application may be made, with prompt effect, in the *bleeding from the socket of an extracted tooth*, which it is sometimes very difficult to arrest.

In severe *uterine hemorrhage*, recourse may also be had to the strong solution of alum as a local styptic; the liquid being injected, or applied by means of a sponge saturated with it, and introduced into the vagina.

Morbid secretions may sometimes be advantageously treated by the topical use of alum. Thus, its solution has been employed in *leucorrhœa, gonorrhœa* and *gleet, profuse salivation, colliquative sweating*, to check *excessive suppuration* from *ulcerated surfaces*, and in cases of *purulent ophthalmia*.*

As an injection into *serous cysts*, a solution of alum, containing four or five grains in the fluidounce, has been employed with the effect of producing a cure; but care is necessary thoroughly to evacuate the cyst afterwards, for fear of exciting inflammation.

---

* Dr. Pereira states that, "in the treatment of the *purulent ophthalmia* of infants, no remedy is perhaps equal to an alum wash;" and Dr. F. J. Farre, editor of the abridged edition of Pereira's Materia Medica (p. 103), adds that "the wash should contain eight grains of alum in an ounce of water, and should be introduced between the lids *every quarter of an hour*. Thus used," he says, "the wash seldom fails." (*Note to the third edition.*)

To obviate *relaxation of tissue*, alum is locally used, commonly in solution, in *flabby* and *fungous ulcers*, and in *prolapsus* of the *uvula, rectum*, and *uterus*. It is employed also in *aneurism from anastomosis*, in order to produce contraction of the vessels. A cataplasm of alum-curd may sometimes be preferable, in the cases of ulcer and anastomotic aneurism. On the same principle of obviating relaxation, may be explained the asserted advantage of alum gargles in some cases of *loss or alteration of voice*. (Bennati, *Bullet. Gén. de Thérap.*, i. 256.)

In the *earliest stage of inflammation*, before any other change has taken place than mere congestion of the vessels, alum applied to the part sometimes arrests the disease, by diminishing the caliber of the capillaries, and thus excluding an excess of blood. For this purpose, it is much used in mucous inflammation of the fauces, or ordinary angina. A gargle made of alum, sage tea, and honey has long been a popular remedy for sore-throat. The remedial impression, however, is due to the alum alone; the other ingredients simply serving to qualify the taste. Some persons are very liable to these anginose attacks, which not unfrequently subject them to great inconvenience, and sometimes to danger, by extending to the larynx, bronchia, or even pulmonary tissue. The attack may often be warded off by proceeding immediately, upon the occurrence of the first symptoms, to gargle the throat with a strong solution of alum; taking at the same time a dose of sulphate of magnesia, and using an exclusively vegetable diet. But when the inflammation has become firmly established, the remedy will generally be useless or worse than useless, until the activity of the symptoms has subsided; when, if a relaxed state of the vessels remain, keeping up a slight chronic congestion, it may be again resorted to with advantage. The form of lozenge has been suggested by M. Argenti, of Venice, as sometimes preferable to gargles. Held in the mouth, and allowed slowly to dissolve, it is kept in constant contact with the diseased membrane, and may be supposed to act more effectually than when the medicine is intermittingly employed. The lozenge may be made by incorporating powdered alum, sugar, and tragacanth, by means of some aromatic liquid.

In the *pseudomembranous form of angina* and *stomatitis*, such as attends *diphtheria*, and in the same condition occurring in scarlet fever, a strong solution of alum, or the salt in powder, is sometimes very effectual. The powder may be applied by means of the finger, or more conveniently by introducing it into a tube, and through this blowing it into the fauces. This application of alum in modern times we owe to Bretonneau. It is generally made in cases of infants, who are most subject to the diphtheritic affection. It is usually followed by a copious salivation, and by efforts to vomit; but these cease after a few minutes. The remedy is equally effectual when applied to the false membrane, which, during the prevalence of an epidemic of the disease, is apt to form on other parts, as the nipple, mucous membrane of the generative organs, and ulcerated surfaces in any portion of the body. It may be used also in obstinate *aphthous incrustations* of the mouth. The alternate application of powdered alum and tannic acid, one or the other being used every hour, has also been recommended in pseudomembranous angina. (*Ann. de Thérap.*, 1859, p. 114.)

Painful caries of the teeth may sometimes be relieved by filling the cavity with a paste made of alum, ether, and a little mucilage, which may be repeated twice a day while the pain lasts. (*Trousseau et Pidoux*, 4e ed., i. 137.)

In *commencing ophthalmia*, alum sometimes arrests the disease; but in this affection, the solution should be much weaker than when used for the throat, or to arrest hemorrhage. When the inflammation is fixed, the remedy is no longer applicable; but it sometimes comes again into play when, in the advanced stage, the eye remains red, and perhaps blood-shot, from a passive distension of the vessels. Another mode of using alum in ophthalmia is in the form of alum-curd, which may be applied as a poultice over the closed eyelids, between pieces of soft linen or gauze. Reference has already been made to its peculiar efficacy in the purulent ophthalmia of infants. (See *page* 140 and *note.*)

Other forms of inflammation, in which alum-curd may be employed, are *chilblain* before the cuticle is broken, and the *erythematous redness* which results from pressure, as in the cases of patients long confined to bed with diseases of debility.

Administration. The dose of alum for ordinary purposes varies from five to fifteen grains, which in chronic cases may be given three or four times a day, and in those more acute, every two or three hours. It may be taken either in powder or solution. In either case, it will often be desirable to make some aromatic addition, to obviate nausea. Five grains of pulverized nutmeg are often added to each dose of the powder; and an equal weight of white sugar may be mixed with it, in order to qualify the taste.

Another form of administration is that of *alum-whey.* This is made by boiling two drachms of the powdered salt with a pint of milk, and straining after coagulation. The dose is from one to three tablespoonfuls.

For external use, the *curd* remaining after straining the milk, in the preparation of the whey, may be employed in the form of cataplasm. Another mode of making an *alum cataplasm* is to rub the white of egg with a piece of alum, in a saucer, until the albumen coagulates; or a drachm of powdered alum may be well shaken or beaten with the whites of two eggs. The curd thus prepared may be applied between folds of soft linen.

The solution of alum for external use is of various strengths, according to the purpose for which it is employed. In commencing ophthalmia its strength should not at first exceed four or five grains to a fluidounce of water; for application to the urethra from five to ten grains. A much stronger solution, containing fifteen or twenty grains in the fluidounce, has been above recommended for various purposes.

Alum is among the substances most used by means of the atomizer. Its solution, containing from ten to twenty grains to the fluidounce, is inhaled in the state of spray, in chronic bronchitis and laryngitis, especially when attended with excessive secretion; and, containing forty grains, has been found useful in pulmonary hemorrhage.

The uses of *Dried Alum* (ALUMEN EXSICCATUM, *U. S.*) will be treated of under Escharotics.

XII. LEAD.

PLUMBUM.

The preparations of lead are here considered, because one of their most prominent properties, and that for which probably they are most employed, is their astringency; though, in other respects, they are quite peculiar, and different in their mode of action from all other medicines. In the metallic state, lead is believed to have no effect on the system. It is true that its introduction into the stomach has been followed by symptoms ascribable to its presence; but there can be little doubt that it underwent chemical change, under the influence of the gastric liquids, before these symptoms were experienced, at least any other than such as could be referred to a mere mechanical agency. The vapour arising from melted lead is capable of affecting the system through the lungs; but it is probably an oxide, and not the metal itself, which acts in this case. According to Mialhe, all the salts of lead, however insoluble in pure water, are in a greater or less degree soluble in the liquids of the alimentary canal, through the agency of the chloride of sodium or potassium there present. All of them, therefore, are capable of being absorbed, and of operating on the system. He does not except even the sulphate, which has usually been considered inert in consequence of its great insolubility. It is now generally believed that none of the known combinations of lead are without some effect, excepting only the sulphuret.*

---

* Sulphate of lead is soluble, to a certain extent, in solution of hyposulphite of soda, and of course might act on the system if it should encounter this salt. (*Journ. de Pharm. et de Chim.*, Janv. 1859, p. 77.) Even the sulphuret of lead is said, when applied as a dressing to an ulcerated surface, to have caused lead-poisoning; so that the metal can hardly be considered safe in any state. (Dr. N. J. Pittman, *Trans. of Med. Soc. of N. C.*, 1856, p. 89.)

1. *Effects upon the System.*

The preparations of lead may act in two ways; *first*, by simply irritating the part with which they may come into contact; and *secondly*, by exercising their peculiar influence, through absorption, either on the part itself, or the system. To a certain extent, these influences are inconsistent with each other; for irritation in a part is well known to impede absorption; and, in proportion as the irritating substance is taken up, and removed from the point of application, is its power of irritating, in any given quantity, diminished. This fact has an important practical bearing. If the peculiar effect of lead is wanted, care must be taken that the preparation be as little irritant as possible. Thus, a quantity of acetate of lead, large enough to irritate the stomach, will be much more likely to operate on the system, when administered in small doses frequently repeated, than when the whole is taken at once. In the latter case, not only is absorption impeded by the fulness of the irritated vessels, but the agent is apt to be removed by vomiting or purgation.

1. *Irritant Influence.* In relation to the irritant effect of the preparations of lead, there is nothing peculiar. They are apt to operate in this way when applied largely, and to delicate surfaces; and the important point for the physician is to be able to regulate the dose of each preparation, according to the susceptibility of the several parts with which it is brought into contact. The skin will bear more than the gastric mucous membrane, and the latter more than the delicate conjunctiva. Some of the preparations act as irritant poisons when swallowed in over-doses. Too highly concentrated, they may indeed occasion the death of a part, either by excess of irritation beyond its vital capacity, or by chemical combination with one or more of its organic constituents.

2. *Peculiar Influence.* This, so far as it can be generalized, is the influence conjointly of an *astringent* and *sedative*. The sedative influence, though felt in some degree in the circulation, is more especially directed to the nervous system, and appears to affect the nerve tissue directly, rather than through the nervous centres, though these may also be involved. When the preparations of lead are given in such doses as gradually to bring the system under their influence, no observable effects may be experienced for some time, in a state of health; but, after a shorter or longer period, which varies much in different cases, the secretions are generally somewhat diminished, and the pulse often lessened in frequency and fulness. These may be considered as their legitimate effects, when they are used therapeutically; and they will sometimes prove useful in restraining morbid discharges, even before any change is noticed in the healthy functions. If longer continued, whether accidentally, or for medical purposes, they are capable of inducing a poisonous condition, which presents very peculiar phenomena, and not unfrequently

ends in death if neglected. Practically, this poisonous condition results much more frequently from exposure to the influence of the metal accidentally, or in the pursuit of business, than from its use as a remedy; no doubt because, in the latter case, its operation is carefully watched, and its employment suspended upon the occurrence of unpleasant symptoms. The toxicological influence of lead was investigated, with peculiar care, by M. Tanquerel des Planches; and, though much was known before the publication of his treatise, and many observations have since been made, yet his account of the symptoms has served as the basis of most subsequent descriptions.

Poisonous Effects. Among the earlier symptoms of lead-poisoning are dryness of the mouth and nostrils, diminished urine, and a tendency to costiveness, with small, dry, and sometimes light-coloured stools, evincing diminished biliary and intestinal secretion. There are often also uneasy epigastric sensations, impaired appetite, colicky pains, and sometimes nausea and vomiting. If the gums are now examined, they will generally present a bluish or slate-coloured line along their margin, of greater or less extent; and the same discoloration will be found to affect the teeth themselves, where joined by the gums. This appearance is ascribed to the formation of sulphuret of lead, probably through the agency of the saliva acting upon the metallic combination in the tissue. It has also been noticed in the mucous membrane of the lips and cheeks. It is said that the habit of cleaning the teeth or gums daily with a brush has some effect in preventing this blue discoloration, the absence of which, therefore, in persons who thus use the tooth-brush is no proof that they may not be labouring under the effects of lead. (Dr. Alexander Smith, *Ed. Med. Journ.*, July, 1856, p. 10.) Except in such cases, the blue line almost always occurs, sooner or later, under the continued use of lead, even when no poisonous symptoms are observed. A sweetish, astringent taste, and a peculiar offensive odour of the breath, are said to accompany the poisonous action of lead, which is also characterized by emaciation, especially of the face, and by a dirty yellowish hue of the conjunctiva and the skin. The circulation is usually somewhat depressed, as evinced by the slow and contracted pulse; and the mind is often dejected. This cachectic condition may exist, for a long time, without any other very striking phenomena; but much more frequently it is attended either with violent abdominal symptoms, constituting a variety of colic, with external nervous disorder in the form of neuralgia or paralysis, or with serious cerebral affections. These different complications may exist in the same or in different persons, and, in the former case, may occur successively, or in a greater or less degree conjointly. The most frequent of them, and usually the first in the order of time, is the affection called variously, colica pictonum, painters' colic, or lead colic, which is ordinarily described as a distinct disease.

Lead colic is characterized by severe pains about the umbilicus, occurring more or less paroxysmally, in general not increased but rather relieved by pressure, with sensations of twisting, and a feeling of wretchedness, often strongly expressed upon the countenance. The walls of the abdomen are usually hard and somewhat retracted, and the muscles not unfrequently gathered into knots. The bowels are obstinately constipated, though there may be frequent desire to go to stool, with straining and tenesmus. Bilious vomiting is not uncommon. The patient loses sleep, and is extremely restless, often changing his position, and sometimes rising and walking about the chamber, with his body stooping, and both hands pressed upon the abdomen. If the cause be withdrawn, these symptoms will generally subside in a few days, especially under appropriate treatment; but they sometimes assume a protracted form, and, more or less moderated in violence, may run on for weeks or months.

Lead palsy may occur among the earlier phenomena, but is generally a sequela of the colic. It may affect sensation and the power of motion severally or conjointly, and, when it affects both, may do so in different degrees. It is frequently accompanied with *neuralgic pains* in the muscles, joints, etc., counterfeiting rheumatism, which are usually continuous, though liable to exacerbations, and are increased by motion, but relieved by pressure. Sometimes there is spasmodic rigidity of certain muscles. The part first attacked with palsy is generally the hand and forearm; and the extensor muscles are chiefly affected, so as to cause the hand, when the arm is held up, to fall as if strongly flexed. The *falling hand* is among the most striking diagnostic symptoms of lead-poisoning. The lower extremities are also attacked in some cases; and there is, particularly in the advanced stages, a general defect of muscular power, evinced by tremulous movements, and especially by trembling of the tongue when protruded. The involuntary muscles participate in some degree in the palsy, and the power of the heart becomes at length very sensibly diminished. The external paralytic and neuralgic complications are generally more difficult to cure than the colic.

By far the most serious effects of lead are *those upon the brain.* They usually occur at the close of protracted cases; but sometimes early, either by themselves, or associated with colic or palsy. Among the most prominent are convulsive attacks similar to those of epilepsy, which are generally fatal. Sometimes the muscles become cataleptic; and sudden comatose seizures imitating apoplexy now and then occur. Impaired sight and hearing, complete amaurosis, diminished general sensibility, delirium, stupor, and coma, are usually the last effects of the poison.

Albuminuria has in several instances been noticed as one of the results of poisoning by lead. It is apt to accompany the cases complicated with cerebral disease and amaurosis, and may serve to account in part for these affections, through the uremic poisoning of the blood.

Lead-poisoning may end fatally in an acute attack, or may last for years, with alternations of exacerbation and remission, of seeming recovery and relapse, or with a more or less continuous course of deterioration of health, under an intermittent or steady exposure to the cause.*

Local Effects. Applied locally, and in a quantity insufficient to irritate, the preparations of lead produce contraction with some diminution of sensibility in the surface, and, if continued, generally occasion a bluish colour, probably by penetrating into the tissue, and forming there some new chemical combination.

Anatomical Changes. The blood is deficient in red corpuscles. In one case examined by Andral, they had been reduced to 83·8 parts in 1000. the mean normal proportion being about 125. The serum has a yellowish hue, as also have the viscera. In some cases, no alteration is observable in the bowels; in others, one portion has been found contracted, and another dilated in the same subject. In cases attended with albuminuria, there is produced in the kidneys, according to M. Lancereaux, a new formation of connective material, which causes the retrogression or absorption of the epithelial cells. (*Ann. de Thérap.*, 1864, p. 215.) No characteristic lesion has been noticed in the brain or spinal marrow; but the muscles long affected with paralysis are usually pale and atrophied, and the heart and blood-vessels are said sometimes to be contracted. Lead has been discovered in the tissue of all the organs which have evinced signs of its poisonous influence during life.

2. *Mode of Operation.*

There can be little doubt that the preparations of lead operate by direct contact with the parts affected, being in the first place absorbed into the blood, and then distributed over the system. By Tiedemann and Gmelin, Orfila, and other chemists, the metal has been detected in the blood, the urine and milk, the brain and spinal marrow, the muscles, the bones, the liver, spleen, and kidneys, and in the coats of the stomach, bowels, and gall-bladder. As it exists in the tissues, it is sometimes not discoverable by the ordinary tests; incineration being necessary to break up the combination in which it is probably held with organic matter. The precise character of this combination, whether in the blood or the solid tissues, is unknown. The system has in general the power of throwing off the poison sooner or later, unless in quantities sufficient to destroy life. It is eliminated by the kidneys, skin, mammæ, and probably by the various secretory organs which empty into the alimentary canal. How long it may remain in the system is not certainly known; but it was found by Orfila in the liver, intestinal coats, and bones of an animal, eight months after it was administered. (*Med. Times and Gaz.*, iv. 279.) It may operate through the susceptibilities of the parts with which it is brought into contact; but there is reason to think that it sometimes at least enters into elementary combination with the tissues, and thus necessarily modifies their action. (See *Arch. Gén.*, 4e sér., xxvii. 75.) It is probably through its presence in the substance of the nerves themselves that it occasions neuralgic pains, and at length loss of power, both sensory and motive. Colica pictonum is a combination of neuralgia and partial palsy of the bowels; and thus the internal correspond exactly with the external effects of the poison.

---

* The influence of the poison, in cases of pregnancy, besides causing abortion, is said either directly or indirectly to extend to the fœtus, leading to arrest of development and even death, and, when these results are avoided, causing various morbid conditions in the infant. Thus, of six cases of pregnancy accompanied with lead-poisoning, observed by M. Constantin Paul, three of the offspring perished in the first six months, and of the three which remained, one was epileptic, one scrofulous, and the third only two months old, so that time had not been allowed for the development of morbid tendencies. (*Arch. Gén. de Méd.*, Mai, 1860, p. 530.) In 123 cases of pregnancy, there were 64 abortions, 4 premature deliveries, 5 still-born. 20 infants who died in the first year, 8 in the second, 7 in the third, 1 later, and 14 living. of whom only 10 were more than three years old. (*Ibid.*, p. 532.) M. Paul also states, as the result of his observation, that lead-disease in the father, as well as in the mother, serves as the cause of the death of the fœtus, and the premature death of the infant. (*Ibid.*, p. 516.)—*Note to the third edition.*

The chief avenues through which lead enters the system are the alimentary canal and the lungs. The skin, and the mucous membranes of the eyes, mouth, and nostrils, may possibly admit its passage in small proportion; but, with the epidermis sound, it is doubtful whether it ever enters through the skin in quantities sufficient to produce poisonous effects. It is very often applied to the surface of the body largely, and for a long time consecutively, even in its most soluble forms, without any observable general effect. When applied to excoriated surfaces and ulcers, it is said sometimes to have occasioned serious lead-poisoning; though I have never witnessed a case of the kind. The particular part upon which it may first display its effects, and the rapidity of its operation, depend in some measure upon the surface of application. Thus, when taken into the alimentary canal, it may be inferred to be more likely to occasion colica pictonum than through any other avenue; but it must be allowed that positive proof to this effect is wanting. It probably acts most readily and rapidly through the respiratory organs. The late J. Price Wetherill, who was long and largely engaged in the manufacture of white lead, informed me that the workmen in his employ, most liable to be poisoned, were those engaged in preparing the thin sheets of lead used in the process. The operation exposed them constantly to the fumes of the melted metal. It is, moreover, well known that painters are more apt to be attacked when they use oil of turpentine in mixing the white lead, than when they employ fixed oil alone; the terebinthinate vapours, in the former case, carrying a portion of the lead with them into the lungs.*

The persons most exposed to the poisonous influence of lead, are those engaged in the different manufactures and arts in which the metal is concerned. Miners and smelters of lead, manufacturers of white lead and other preparations of the metal, painters, plumbers, etc., are apt to be affected.† The poison is frequently taken in with food or drink; and in many instances its ill effects are allowed to continue long, and are perhaps misinterpreted, because the source of impregnation is hidden. The practitioner should be careful to guard against mistakes of this kind, and, whenever symptoms analogous to those of lead-poisoning come under his observation, should diligently search for the cause in the occupations, habits, diet, and various exposures of the patient. The blue discoloration of the gums is an invaluable sign in such instances. It is not only those engaged in the processes in which lead is used who are liable to be affected, but also all who may be exposed, from residence or accidental vicinity, to the same influence. In relation to *food*, independently of the occasional presence of the preparations of lead from pure accident, carelessness, or malicious intention, the poisonous impregnation may proceed from the use of lead-glazing for earthen-ware, or of soldering in metallic vessels, especially when acid substances are introduced into them, as in the instance of pickles or preserves. But drinks are much more liable to this impurity. Water, through the agency of the absorbed oxygen and carbonic acid, always contained in it when exposed to the air, is capable of acting on metallic lead, forming an oxide or carbonate, which may be held in solution in minute proportion. Of course the same result must happen from contact with the carbonate already formed. Hence, lead-poisoning has often proceeded from the use of water as drink, which had stood long in leaden reservoirs, or passed through leaden pipes; and the similar use of rain-water falling from a painted roof has produced the same effect. Certain natural waters, in consequence of the protective agency of the salts which they contain, are less liable to be thus rendered noxious than pure water. This is particularly true of those containing carbonates and sulphates. It has been supposed that these act by forming carbonate and sulphate of lead, which, being insoluble, are precipitated as rapidly as they are formed, and, giving a coating to the surface, prevent the contact of the water with the metal. This may be partially true; but such a coating must be an uncertain protection, and in fact has often proved insufficient. A better explanation of the effect of these salts is, I think, the following. The carbonates and sulphates referred to are usually those of lime. In the instance of carbonate of lime, which is in fact a bicarbonate, the proper carbonate being insoluble, one equivalent of the carbonic acid seizes the oxide of lead, as fast as formed, and the reproduced carbonate then appropriates the free carbonic acid in the water, which is thus rendered incapable of acting as a solvent to the carbonate of lead produced; for this carbonate is quite insoluble in pure water. A little carbonate of lime in the water may thus serve as a carrier of the carbonic acid from the water to the oxide of lead, and keep the liquid free from both. In the instance of the sulphate of lime, the sulphuric acid combines with the oxide of lead as rapidly as it is generated, or decomposes any carbonate of lead that may have been produced, in either case forming a totally insoluble sulphate of lead, while the liberated lime would neutralize any free carbonic acid in the water. It is thus seen that these salts preserve the purity of the water, not simply by forming a mechanical impediment to its contact with the lead, but by separating the impurity at the moment of its generation. It is in this way probably that the Schuylkill water, with which the city of Philadelphia is supplied, is kept free from lead, though constantly flowing through leaden pipes. Water containing chlorides is not similarly protected. I have known colica pictonum to prevail in a neighbourhood where the pump-water is brackish, simply from the introduction, as a substitute for the common pump, of an apparatus containing a small portion of leaden pipe.

---

* A case is recorded in which the disease originated from inhaling the fumes of old painted wood undergoing combustion; the poison arising no doubt from the carbonate of lead in the paint. (*Journ. de Pharm. et Chim.*, Mai, 1866, p. 884.)—*Note to the third edition.*

† In many instances, the source of the poisoning is very obscure, and requires a close investigation for its discovery; but the symptoms are so peculiar that they must always lead to suspicion, however little apparent cause there may be even to imagine the presence of lead. Thus, the working people in a factory in France, whose business was to give a certain vitreous coating to iron, were attacked with the symptoms of lead-poisoning, which, on investigation, were found to be owing to the use of a kind of crystalline matter, containing a small proportion of oxide of lead. In the process of manufacture, this material was reduced to a fine powder, which was more or less agitated, causing the suspension of some particles in the air, which, being inhaled, were the source of the mischief. (Dr. Archambault, *Arch. Gén. de Méd.*, Avril, 1861, p. 129.) The same result would probably follow exposure to the dust of powdered flint glass, or any other containing lead. (*Note to the third edition.*)

Carbonic acid water is capable of dissolving a small proportion of lead. I have known of two cases of colica pictonum produced by drinking, every morning, the first draught from a soda-water fountain; in the leaden pipe proceeding from which, the liquid had been allowed to stand over night.

The use of fermented and spirituous liquors containing lead has been a fruitful source of poisoning. Cider has sometimes been kept in leaden vats, or vessels having lead in or about them, and thus become impregnated with malate or acetate of lead with the most fatal effects. I have been informed of cases of lead colic, produced by drinking cider which had been allowed to run from the press through a spout of that metal. Wines have become poisonous in a similar manner; and sometimes also by the purposed addition of metallic lead, or acetate of lead, to improve their flavour. I have seen an account of large numbers of a regiment in the East Indies having been poisoned by drinking arrack containing lead.

Even the metal itself, in the ordinary state in which it exists of partial oxidation upon the surface, is not without effect. Lead-poisoning has been produced by the habitual chewing of sheet-lead, such as lines the tea-chests from China.*

I have given the above particulars by no means as illustrating all the sources of lead-poisoning, but as examples, which may serve to direct the inquiries of the inexperienced practitioner, in any suspected case of the kind.†

3. *Treatment of the Effects of Lead.*

When a quantity of any one of the preparations has been swallowed, sufficient to produce severe irritation or inflammation of the stomach, an emetic of ipecacuanha should be immediately administered, along with sulphate of magnesia, or other harmless sulphate, as an antidote, and with free dilution. The salt acts by forming with the preparation of lead the insoluble and comparatively innocent sulphate of that metal. After the stomach has been thoroughly evacuated, a cathartic dose of the sulphate of magnesia or of soda should be given, to decompose and carry out of the bowels any of the poison which may have entered them. The remaining treatment must consist of measures calculated to remove any irritation or inflammation that may have been produced; as the use of opiates, demulcent drinks, counter-irritation to the epigastrium, and, if necessary, leeching.

---

* A very interesting account has been published of extensive lead-poisoning, affecting upwards of 200 persons in a limited community in Orange Co., N. York, which was found to be owing to the use of flour obtained from a certain mill, in which defects in the surfaces of an old pair of stones had been obviated by filling the cavities with melted lead, whereby particles of the metal, separated in the attrition, had become mingled with the flour. (*Am. Journ. of Pharm.*, July, 1866, p. 366, from N. Y. Tribune, June 2.) Even the use of cosmetics containing lead is believed to have been a source of the disease; and a case of the kind was observed by Dr. W. Couzins, of London. (*Med. T. and Gaz.*, Sept. 1864.)—*Note to the third edition.*

† A very slight degree of impregnation with lead is sufficient to render water poisonous, when used as an habitual drink. In one instance where a whole village suffered from this cause, Mr. Herapath found the proportion of lead not to exceed half a millionth of the weight of the water. Indeed, the proportion is so small as, in the dilute state, to be insensible to the test of hydrosulphuric acid. Under such circumstances, Mr. Herapath evaporates a portion of the water to dryness, treats the residue with nitric acid, and, dissolving the product in a small proportion of water, passes hydrosulphuric acid through the solution. The smallest proportion is thus detected by the dark colour produced; the nitrate being more sensible to the test than the bicarbonate, in which state the lead is usually held in the water. (*Pharm. Journ. and Trans.*, xviii. 618.)

The peculiar poisonous effects of lead require a different treatment. In such cases the metal has entered the blood, and is probably lodged in the various tissues. The indications are to obviate the pathological conditions produced, and to eliminate the poison from the system. Sulphuric acid and the different sulphates have been recommended as antidotes; but it is obvious that they are not calculated to correct the action of the absorbed poison in this way; for, if absorbed themselves, they could act only by converting the combination of lead, existing in the blood or the tissues, into a sulphate, which, from its comparative insolubility, would resist elimination, and might continue to exercise a noxious influence, if fixed in the solids. It is only by operating on any portion of the poison existing in the alimentary canal, that they could do good in this way; and when there is reason to suppose that such a condition of things exists, they should be employed. The sulphurets have a similar antidotal power; but, from their more irritant properties, they are seldom given internally. Used externally in the form of bath, they prove advantageous by converting into the inert sulphuret any preparation of lead that may adhere to the surface; and probably still more so, by disposing, through their chemical agency, to an elimination, upon the surface of the body, of the lead which may be circulating in the blood. It is asserted that, in cases of saturnine impregnation of the system, the use of these baths is followed by the production, upon the skin, of a dark matter, which is the sulphuret of lead. The result may, it is true, be ascribed to the excretion of the lead by the skin, through the unaided powers of the system; and the antidote may act simply by forming a sulphuret with the excreted metal. Even in this case, it might prove useful by putting the poison into a condition unfitting it for reabsorption; but the probability, I think, is, that it has a positive power of elimination through its affinity for the lead in the blood-vessels, acting through the epidermis and the capillary walls; and that thus the poison is withdrawn much more rapidly than it would be by the excretory power of the skin alone. The bath may be made by dissolving four ounces of sulphuret of potassium in thirty gallons of warm water, in a wooden tub. After immersion, the dark coating formed should be removed from the surface by scrubbing with a stiff flesh-brush, with soap and water; after which the patient should be again immersed, and the process repeated so long as any obvious discoloration of the skin is produced. In a short time, a renewal of the bath will be found again to discolour the skin. The measure, therefore, should be repeated twice a week, and not abandoned until this effect ceases to be produced, which may not happen for many weeks.

Another method by which lead may be eliminated from the system, is through the agency of some body, which, received into the blood, and circulating with it, may be brought into contact with the insoluble compound of lead in the tissues, and, rendering it soluble in the blood, may enable that fluid to take it up, and discharge it through the different emunctories. Iodide of potassium, which, in an alkaline solution, has the property of dissolving lead, was recommended for this purpose by M. Melsens, and was found by him to be one of the most efficacious remedies in lead-poisoning. According to this theory of its action, evidences should be presented of the absence of lead in the urine or other excretions before the use of the iodide, and its presence afterwards. This evidence M. Melsens did not produce; but, subsequently to the publication of his memoir, Dr. E. A. Parkes, of London, found the requisite proof in a case which came under his notice (*Brit. and For. Medico-chirurg. Rev.*, Am. ed., xi. 411); and Dr. H. S. Swift, of New York, has given an account of no less than twenty-three cases, in which the iodide was used very advantageously in obstinate lead-poisoning, and in many of which lead was detected in the urine after the use of the remedy, though in no instance could it be discovered previously. (*N. Y. Med. Times*, iii. 145.) M. Melsens found, in his experiments on animals, that the poisonous effects of the lead were increased when the iodide was early employed, probably in consequence of its rendering the poison in the alimentary canal more soluble, and consequently more readily absorbed; and it is not impossible that the liberation of the lead from certain tissues, and its reintroduction into the blood, may occasionally, for a time, aggravate the symptoms. Dr. Swift noticed this in two out of twenty-three cases; but the aggravation was slight, and improvement was soon evinced. From five to twenty grains of the iodide may be given three times a day, and continued until the symptoms of poisoning cease. One evidence of improvement is the disappearance of the blue discoloration of the gums produced by the lead.

The above remarks are applicable to lead-poisoning in general. Particular forms of it require special modifications of treatment. In the form of colic, it is necessary to relieve the pain, and overcome the obstinate constipation. For this purpose, the preparations of opium are to be employed in connection with purgatives, of which calomel, croton oil, castor oil, and sulphate of magnesia are perhaps the best. The last-mentioned remedy has the additional advantage of converting the poisonous preparation of lead in the bowels into the sulphate. The purgatives may be aided by cathartic enemata. Tobacco cataplasms, and chloroform over the abdomen, have been recommended for the purpose of relieving pain and relaxing spasm; and the latter remedy has been used internally with the same view. The mercurial impression has been considered as antidotal to the saturnine, and calomel with a view to salivation has been considerably used; but it is seldom necessary. *Alum* often acts most happily in the disease, sometimes speedily relieving all the symptoms, when the opiate and purgative plans have failed. It may be employed conjointly with them from the beginning of the treatment. It has been supposed to operate chemically, either upon the poison remaining in the bowels, or on that contained in the tissue of their coats, by converting the compound of lead into a sulphate; but, were this its mode of action, the same effects should be obtained from diluted sulphuric acid or Epsom salt, which have not been found to answer as well in practice. As the insensibility of the bowels to purgative influence is probably owing to a partial condition of paralysis, the use of strychnia is indicated in obstinate cases.

In the paralytic cases, besides the use of the antidotal measures above referred to, and especially iodide of potassium and sulphuretted baths, recourse may be had to strychnia, electricity, and the application of blisters; and the mercurial impression may be tried, should other measures fail. When neuralgic pains complicate the palsy, opiates or other anodynes may be conjoined with the antidote.

In the cerebral cases, whether convulsive, comatose, or delirious, general and local bleeding, cold to the head, sinapisms or blisters to the extremities, and purgation have been generally deemed advisable; and, should the state of the circulation call for these remedies, they should undoubtedly be employed. But there is reason to believe that these phenomena, sometimes at least, depend upon a direct impression made by the lead upon the cerebral centres, analogous to that upon the bowels and the external muscles; and, as this is rather of a depressing than excitant character, it may be a question, whether opiates and other cerebral stimulants may not prove more effectual than depletory measures. In a fatal case, with violent delirium, spasmodic rigidity of the muscles, and convulsions, ending in coma, in which the depletory and revulsive measures were employed with no effect, no sign could be discovered after death of inflammation or active congestion of the brain or its membranes. (*Arch. Gén.*, 4e sér., xxvii. 71.) In such a case, if attended with an unexcited state of the pulse, and paleness of the face, I should be disposed to try the plan referred to, of course in conjunction with the proper antidotal measures.

Prevention. In relation to preventive measures, the best rule is to guard, by extreme care, against the introduction of the poison into the system. For this purpose, the cautions should be observed to keep the hands and surface of the body clean, and, as far as possible, to avoid swallowing any of the poison whether in food, drink, or mixed with the saliva. It cannot be kept from the lungs when the air inspired is impregnated with it; but much may be done for self-protection by preventing this impregnation, and by avoiding the inhalation of the poisoned atmosphere. Thus, in the manufacture of white lead, it has been found that the disease is less prevalent since the introduction of grinding the salt under water, than when it was powdered dry, and thus caused to fill the air with its fine particles. The habitual use of sulphuric acid, diluted so as to form an agreeable drink, has been recommended as a preventive to those who are necessarily exposed. But it is evident that the acid can act only on the portion of the poison swallowed; and, as the sulphate has been shown not to be altogether innocuous, it cannot be a complete safeguard even against this; while the steady use of a substance so active as sulphuric acid cannot itself be without its inconveniences.*

4. *Therapeutic Application.*

The therapeutic indications to be fulfilled by the preparations of lead, based upon their astringent and sedative properties, are mainly to arrest hemorrhage and morbibly increased secretions, and to reduce inflammation. But it will be most convenient to consider the remedial uses of the metal, under the head of its several preparations, and especially under that of the acetate, which is the only one much employed internally.

5. *Preparations of Lead.*

I. ACETATE OF LEAD.—PLUMBI ACETAS. *U.S.*, *Br.*—*Sugar of Lead.*—*Saccharum Saturni.*

Acetate of lead is prepared by the action of vinegar, or other form of dilute acetic acid, either upon plates of metallic lead oxidized by exposure to the air, or directly upon the protoxide of lead with the aid of heat. It is the neutral acetate of the protoxide of lead, consisting of one equivalent of acetic acid, one of protoxide of lead, and three equivalents of water.

Sensible and Chemical Properties. This salt is in the form of shining, white, acicular crystals, isolated or in masses, efflorescent, of a sweet and astringent taste, and often, when long kept, of an acetous odour, owing probably to the action of the carbonic acid of the air, and the slow escape of acetic acid. It is readily dissolved by water; and the solution has a white turbid appearance, which, when the water is free from saline impurities, is removed by the addition of vinegar or acetic acid. The whiteness is owing to the carbonate of lead, formed by the combination of the carbonic acid, which is contained in all natural waters, with a portion of the protoxide of lead, liberating the acetic acid, and thereby giving the solution an acetous smell. In hard waters, the white precipitate is usually a sulphate or chloride of lead, and not redissolved. Distilled water, recently boiled, forms a perfectly clear solution with the acetate, if quite pure; but, as found in the shops, the salt often contains a portion of carbonate, in which case the solution will be more or less opaque.

---

* In the instances, in the arts, in which water has to pass through leaden pipes, it is recommended by M. Schwartz, of Breslau, that the pipes, before being used, should be filled with a concentrated solution of an alkaline sulphuret, whereby their internal surface receives an insoluble and impermeable varnish of sulphuret of lead, perfectly protecting the water from contact with the metal. (*Repertoire de Pharmacie*, Nov. 1868.)—*Note to the third edition.*

Incompatibles. Acetate of lead yields precipitates with sulphuric, phosphoric, citric, tartaric, meconic, and carbonic acids,* and all the soluble salts of these acids; with hydrochloric and hydriodic acids, and all the soluble chlorides and iodides; with hydrosulphuric acid, and the soluble sulphurets; with tannic acid, and consequently all the vegetable astringents; with certain mucilages, and especially that of slippery elm bark, but not with pure gum; with chondrin and albumen; and with lime-water, and solutions of ammonia, potassa, and soda, the last two redissolving the precipitate if added in excess. The precipitate formed with the sulphurets is black, with the iodides yellow, and with the other reagents mentioned white or whitish. But, though the above substances are chemically incompatible, it does not follow that they are medicinally so. On the contrary, many of the precipitates are probably not less efficient than the acetate; and, in fact, this salt is often exhibited in connection with substances which decompose it. What it is necessary for the practitioner to guard against is the addition of the incompatible substances in solution. In the form of pill or powder, they may frequently be added with advantage, when remedially indicated. The only substances which should always be avoided are sulphuric or hydrosulphuric acid, and the soluble sulphates or sulphurets; as the precipitates formed with these are feeble, if not inert. It is probable that acetate of lead is always decomposed in the alimentary canal, either by the hydrochloric acid or the chlorides in the stomach, or hydrosulphuric acid in the bowels.

Effects upon the System. Acetate of lead has all the effects upon the system which have already been described as characterizing the preparations of lead in general. In large doses, or unsuitably applied, it is irritant; but, when so employed as to obtain its peculiar influence, it is astringent and sedative.

1. Its irritant effects are shown when it is applied in strong solution to delicate surfaces, as to the conjunctiva, the urethra, or the skin denuded

---

* I have verified by experiment the decomposition of perfectly neutral and pure acetate of lead by carbonic acid. The whole of the salt, however, is not decomposed; as, when the acetic acid has attained a certain degree of excess, it appears to prevent the further action of the carbonic acid.

of the cuticle, or when taken too largely into the stomach. Orfila found it, when introduced in large quantity into the stomach of dogs, to occasion fatal inflammation; and the gastric and intestinal mucous membrane was observed to be whitened by its chemical action. In man, when taken in excessive doses, it generally produces vomiting, burning pain in the œsophagus and stomach, and tenderness in the epigastrium, usually followed by severe griping in the bowels, and sometimes by convulsions, coma, and local palsy, especially if the bowels are not acted on. Its dangers, however, as an irritant poison, were formerly much overrated; for, though often taken accidentally in quantities varying from a drachm to an ounce, no fatal case is, I believe, on record from its immediate effects. Being frequently prescribed for external use, at the same time that Epsom salt is directed as a cathartic, it has occasionally been swallowed instead of the latter, which, in its turn, has been applied locally; and this accident should be carefully guarded against by the practitioner. I was once called to a case of the kind, in which two drachms of the acetate had been swallowed, with the effect of producing severe gastric pain; but, before I reached the patient, a dose of sulphate of zinc had been taken, which caused vomiting, and no injury ensued. What quantity, therefore, may be considered as poisonous, in reference to the irritant action, it is impossible to say; but this much may be inferred, that there is less danger to life from its temporary influence in an excessive dose, than from the same amount given in minute doses frequently repeated, and spread over a considerable length of time. The mode of treating its poisonous effects, as an irritant, has been given under the general head of the preparations of lead. The best antidote is sulphate of magnesia, or sulphate of soda.

2. It has been doubted whether acetate of lead is capable of producing the poisonous constitutional effects of the metal, especially if protected against conversion into the carbonate by an excess of acetic acid. Certainly, considerable doses have been given daily, and continued long, without any observable influence on the general system; and the extreme fear formerly entertained by many, as to the danger of its internal use as a medicine, has been shown to have had little foundation in fact. Nevertheless, that it is capable of producing, when incautiously or recklessly employed, all the dangerous constitutional effects of lead, has been abundantly proved by experience. Dr. Mulford, of Camden, N. J., many years ago, assured me that he had witnessed two cases of colica pictonum resulting from its medicinal use; and many instances to the same effect have since been placed on record. Death has occurred in one instance from colic and paralysis, in a boy of fifteen, to whom from one to eight grains, in divided portions, were given daily until the whole amounted to somewhat more than two drachms. In the *Provincial Medical and Surgical Journal* (June 27th, 1849), Dr. William Norris,

of Stourbridge, relates an occurrence in which nearly a thousand persons were more or less poisoned, in consequence of a mistake made by a baker, who mixed thirty pounds of acetate of lead, instead of the same quantity of alum, with sixty or eighty sacks of flour. It may be said that, in this case, the acetate was decomposed before being taken. It probably was so; but not more certainly than it is decomposed in the stomach, after having been swallowed. Dr. L. S. Jones, of Accomack, Va., has related a case of obstinate colica pictonum, which resulted from thirty grains of the acetate, given in four days, though care was taken to accompany the use of the medicine with vinegar. (*Stethoscope*, i. 664.) It is proper, therefore, to observe some caution in the use of this medicine. With such caution, I believe it may always be given safely. I have been in the habit of using acetate of lead for forty years, have given it in a vast number of cases, and though, after a certain continuance of the medicine, griping pains in the bowels have generally occurred, often with nausea and general malaise, I have never witnessed more than one instance in my practice, in which anything that could properly be denominated colica pictonum has resulted. I have not unfrequently prescribed two grains every two hours through the day, and continued it for several days, sometimes even for weeks, before any sign of its constitutional effects were evinced. I have, however, always been careful to suspend the medicine as soon as the effects on the stomach and bowels just referred to, or a blue discoloration of the gums, have been noticed.

Therapeutic Application. This medicine is much used for the general purposes of the astringents. In consequence of its combination of sedative with astringent properties, it will frequently act very efficiently in the relief of inflammation, when brought directly into contact with the surface affected; and it is to this agency that much of its therapeutic value is to be ascribed. I shall first treat of its internal, and subsequently of its external or local use.

1. *Internal Use.* The *hemorrhages* are among the complaints in which it is most useful. Its sedative property gives it a great advantage in these affections, especially when of the active kind, over other astringents, which, being somewhat, however slightly, stimulant, cannot always be employed with propriety in the early stage. Acetate of lead may always be given when the indication exists to suppress the discharge. But, from the facility with which lead is absorbed, the medicine is peculiarly adapted to those cases in which the affected part can be reached only by the medium of absorption and circulation. When the seat of the hemorrhage is such that the astringent can be directly applied to it, alum is probably more efficient as a mere hemostatic. Such are the cases of hemorrhage from different parts of the alimentary canal. But in *hemorrhage from the lungs*, acetate of lead is preferable to all other astringents, and is very much used. In *hemorrhage from*

the kidneys, and *from the uterus*, it is also one of the best remedies. In the former, I have seen it promptly effectual, and would strongly recommend it. In all these cases, but especially in hæmoptysis, it should generally be combined with a little opium to prevent irritation of stomach, and with ipecacuanha if there is febrile excitement, without nausea or a tendency to it. The opiate is peculiarly indicated in the pulmonary affection, from its effect in quieting the cough. About one-sixth of a grain of opium, and an equal or double quantity of ipecacuanha, may be combined with each dose of the acetate. Though, as above stated, alum is probably more effectual in *hæmatemesis* and *intestinal hemorrhage*, yet the salt of lead is frequently employed in these affections, and not without advantage. It should in these also be combined with opium.

In certain conditions of *diarrhœa*, this medicine is very useful. I do not think it adapted to the acute form of the disease, attended with inflammatory excitement; but rather to chronic cases with copious and exhausting discharges, with or without ulceration of the small intestines; and I have also found it extremely useful in certain cases, whether recent or of long standing, in which, without evidences of inflammation, the evacuations are very copious, and of a whitish gruel-like appearance from the absence of bile. In these latter cases, it should be given in combination with small doses of calomel and opium, and frequently repeated.*

In *epidemic cholera*, with exhausting rice-water discharges, the above-mentioned combination is, I think, the most efficacious which can be employed; but the urgency of the danger in this case demands larger doses than simple diarrhœa; as it is of the utmost importance to produce a prompt impression.

The advanced stages of *cholera infantum* may sometimes be treated advantageously with this astringent. It may be tried in all obstinate cases of the disease, in connection with opiates, and with a little calomel or blue mass when bile is wanting in the passages. Occasionally it has been found efficient, not only in arresting the diarrhœa, but also in correcting the irritable stomach of this disorder, probably by an antiphlogistic influence on the gastric mucous membrane.

It is the same antiphlogistic action which has recommended it in *dysentery*, in the treatment of which it is highly esteemed by some. Its use in acute dysentery originated with the late Dr. Richard Harlan, of Philadelphia; and has found many advocates. I confess, however, that my experience with it, in the ordinary forms of this affection, does not accord with theirs. It no doubt appears to act favourably in some cases; but I have often met with others, in which, after an employment of several days, it has increased the griping and uneasiness of the patient, without any beneficial influence over the disease, and in which the symptoms have speedily subsided, under proper treatment, after its omission. But in chronic cases, with rather copious discharges, it is often useful. I shall have occasion directly to refer to a condition of dysentery, in which it may be employed as an injection with the greatest advantage. As in other bowel affections, it should in this also be associated with opium.

---

* The following formula may be used. ℞. Plumbi acetat., gr. vj; Hydrarg chlorid. mit., Opii pulv., āā gr. j; Acaciæ pulv., Syrup, āā q. s. Mix, so as to form a mass, to be divided into six pills, of which one may be taken every half hour, hour, or two hours, according to the urgency of the case.

In reference to its antiphlogistic effects, acetate of lead has been used with great supposed advantage in *pneumonia*, especially in the old, and in other cases in which bleeding has been sufficiently employed, or may be contraindicated. (*L'Union Médicale*, No. 82.) But pneumonia so often ends in recovery under any treatment, that reports of the efficacy of one or another remedy must be received with great hesitation.

Excessive *sweating*, exhausting *diuresis*, *copious mucous* or *purulent discharges* from the respiratory and urinary passages, and *abundant suppuration*, from whatever source, have been considered as offering indications for the astringent influence of acetate of lead. In *phthisis* it has been recommended for the night-sweats, the muco-purulent expectoration, which is sometimes exhaustingly copious, and the diarrhœa, either severally or conjointly. As to the night-sweats, I think they are, in general, more effectually and more safely controlled by other means, less calculated than acetate of lead to disturb the digestive process, which it is all-important to sustain. The same remark is applicable to the expectoration. In these affections, therefore, separately, I would not advise the remedy; but, when they exist in combination with obstinate diarrhœa, and a chronic sub-inflammatory condition of the gastric mucous membrane, the indication for its use, in reference to the latter conditions, is perhaps strengthened by the possible benefit which may be hoped for from it, in reference to the former.

Obstinate *mercurial salivation* is said to have yielded to the internal use of this remedy; but its local application is preferable.

In *yellow fever*, acetate of lead was strongly recommended by the late Dr. Irvine, of Charleston, S. C. It is only in the second stage, after the subsidence of the first long febrile paroxysm, that the remedy should be employed. At this period, with greatly reduced powers of system, and probable depravation of the blood, there is usually phlogosis of the gastric mucous membrane, with a tendency to prostrating hemorrhage, in the form either of unaltered blood or black vomit. Should the blood be fatally depraved, no medicine could save the patient; but in doubtful cases, where a slight impression might turn the scale in the favourable direction, it seems reasonable to expect benefit from a medicine, calculated, by contracting the vessels, and exercising a sedative influence on the nerves, at once to correct the inflammation and obviate the hemorrhage. I have, myself, used the acetate of lead under these circumstances, in a few instances, and in all with favourable results. In one case, there was an appearance, in the evacuations from the stomach, of commencing black vomit. Two grains should be given, with a little opium, every two hours, and continued until thirty-six or forty-eight grains have been taken, or until the dangerous period is past, unless some unpleasant effect of the medicine should be previously experienced. I would repeat, that the acetate is not to be used until the first febrile symptoms have begun to subside, which is usually on the second or third day.

In *enteric or typhoid fever*, acetate of lead would seem to be indicated as an alterative and antiphlogistic remedy for the diseased state of the mucous membrane of the ileum. Hence, it has been recommended in this affection by the German practitioners. In this country, it has been employed very successfully by Dr. John L. Atlee, of Lancaster, Pa., who gives it in doses of from one to three grains every two, three, or four hours, commencing, after having first evacuated the bowels by a mild cathartic, and persevering so long as the enteric symptoms continue. I cannot speak of the remedy from experience, having never used it in this complaint.

In the *irritable stomach of bilious fever*, and in other cases of *obstinate vomiting*, the medicine has been employed with supposed advantage; though it might be difficult to say, in many instances of this kind, how much was due to the acetate, and how much to the opium usually given along with it.

Aneurisms of the aorta and *of other large internal vessels* have been treated with some advantage by acetate of lead. Introduced into use originally in Germany, the practice was imitated by Dupuytren and others in France; and I have myself tested its efficacy in some degree in this country. The astringent and sedative influence of the preparations of lead would seem to be indicated in this affection; and several instances are on record in which the tumour has very much diminished in size under the use of the acetate. (*Arch. Gén.*, 3e sér., v. 443.) In one of several cases in which I employed it in the Pennsylvania Hospital, an aneurismal tumour, which showed itself projecting from the thorax near the left sterno-clavicular junction, underwent a marked diminution, and became at length scarcely perceptible; but the patient left the house before any definitive result was obtained. I am not aware that any satisfactory case of a complete cure by this remedy has been reported. Indeed, considering the condition of the coats of the vessels in internal aneurism, altered as they generally are by atheromatous deposit, cartilaginous or bony degeneration, or other organic affection, a cure by this measure would be in most cases impossible; and, even when no insurmountable difficulty of this kind might be in the way, few constitutions would probably be found to tolerate, and few patients to submit to the long-continued and persevering use of the medicine which would be necessary to success. The plan is to give six or eight grains of the acetate daily, in doses of one or two grains, at equal intervals, and to continue until nausea or griping pains in the bowels, or other symptoms of lead-poisoning are exhibited; then to suspend the remedy until these symptoms have subsided; after which it is to be resumed; and thus alternately, until the end aimed at is effected, or found to be unattainable.

Simple enlargement of the heart, independent of disease of the valves, would seem to offer quite as good a chance of success, under this treatment, as internal aneurism. I have employed it in cases of this kind; and, in one of great cardiac dilatation in a boy, found the dimensions of the heart, as indicated by percussion, to diminish considerably. What finally became of the case I do not know; as the patient passed from under my care in the midst of the treatment.

Acetate of lead has been used in various *nervous diseases*, as *epilepsy*, *hysteria*, *hooping-cough*, and even *tetanus;* but few would at present expect from it any very material benefit in these affections. I remember to have seen somewhere an account of a case of hydrophobia which had ended favourably under its use; but there can be little doubt that the disease was mistaken.

2. *Local or External Use.* Under this head, it is intended to embrace all those modes of using the remedy, in which it is brought into direct contact with the seat of its intended operation through extraneous agency, including injection into the various passages opening externally, as well as application to the surface of the body. In these it acts upon the same principles as when used internally. But it is more especially for its antiphlogistic effects that it is employed. As a mere styptic, either for arresting hemorrhage, or controlling increased secretion unconnected with inflammation, as excessive sweating for example, it is less efficient than alum, or probably the vegetable astringents. In reference to the mucous surfaces, it is, as a general rule, better adapted to the earliest stage of inflammation, or the very advanced stage when suppuration has taken place, or to the chronic forms of the affection, than to the condition of acute inflammation in full vigour. But this remark does not apply to affections of the skin, protected by the cuticle.

As an *eye-wash* in *ophthalmia*, from one to two grains of the acetate may be dissolved in a fluidounce of rose-water, or simple distilled water.

In *chronic inflammation of the nasal passages, with purulent discharge*, a solution containing from ten to twenty grains to the fluidounce of water, may be injected or otherwise introduced into the nostrils, once or twice daily, with hope of benefit. Care, however, should be taken, in such cases, that none of the solution is swallowed.

Chronic suppuration of the auditory meatus may be treated in a similar manner; though it would be prudent to commence with a weaker solution, say from two to five grains to the fluidounce, and to increase if found necessary.

As a mouth-wash or gargle, acetate of lead is chiefly employed in cases of *mercurial salivation*, in which it is one of the best applications. For this purpose, the solution may have the strength of two or three grains to the fluidounce to begin with. It often blackens the teeth and tongue, in consequence of the formation of sulphuret of lead, through reaction with the sulphur contained in the salivary liquids. But this discoloration is of no serious importance, and gradually disappears. In ordinary ulceration, or pseudomembranous affections of the mouth and fauces, sulphate of zinc, or nitrate of silver, in solution, is more effectual than the salts of lead.

In certain cases of *dysentery affecting the rectum* especially, and attended with little general disturbance of the system, a solution of acetate of lead, injected into the rectum, often serves an excellent purpose. It will sometimes put an almost immediate end to cases, which have proved tedious under other treatment. From four to six fluidounces of a solution, containing two or three grains of the acetate in each fluidounce, with thirty or forty drops of laudanum in the whole quantity, should be injected three times a day. The laudanum is useful by facilitating the retention of the liquid, as well as by directly calming irritation. It is true that the meconate of morphia is converted into the acetate, while a little insoluble meconate of lead is formed; but this result is of no practical importance. It may be obviated, however, by substituting for the laudanum one-quarter or one-third of a grain of acetate of morphia.

Enemata composed of ten grains of acetate of lead, dissolved in six fluidounces of warm water, and administered every two hours, are said to have been used, with remarkable success, in *strangulated hernia.*

In *gonorrhœa* and *leucorrhœa*, injections of the salt are often very useful. For the effectual treatment, however, of these affections, the solution should be very frequently repeated, so that the impression may be steadily maintained. In gonorrhœa, the injection should be administered not less than six times a day, at equal intervals. It should be at first of the strength of two or three grains to the fluidounce, which may be increased if necessary.

Perhaps for no purpose is this salt more employed than for the relief of *inflammatory affections of the skin* and the *subcutaneous tissue*. In *erysipelas*, when the inflammation is very high; in the more inflammatory forms of *erythema*, as *E. nodosum;* in certain cases of *herpes*, *eczema*, and other cutaneous eruptions attended with much heat, pain, and redness; in inflammation of the subcutaneous areolar tissue, either arising spontaneously, as in *phlegmon*, or resulting from *sprains, bruises*, etc., and in acute *swelling of the external lymphatic glands*, a solution of acetate of lead is often highly useful in the alleviation or cure of the inflammation. For these purposes, two drachms of the acetate may be dissolved in a pint of soft water; the turbidness being corrected by a fluidrachm of vinegar or diluted acetic acid. In some cases, laudanum or acetate of morphia may be usefully added. The solution may be applied by means of folded linen wet with it, or in the form of the *cold poultice*, made by mixing the solution with crumb of bread, and enclosing the soft mass in linen or gauze.

It is customary, in cases of superficial inflammation, particularly the erysipelatous, to apply mucilaginous solutions with a view to their antiphlogistic effect. This may be increased by the addition of acetate of lead to the solution; but it should be remembered that this salt is incompatible with certain mucilages, particularly with those of *slippery elm* and *quince-seeds*, with which it forms precipitates, and thus deprives the liquid of its mucilaginous property. But with the mucilages of *flaxseed* and the *pith of sassafras* it reacts but slightly, not sufficiently to impair materially their demulcent properties, or to interfere with its own efficiency. These latter mucilages, therefore, should always be selected, preferably to those first mentioned, for external use in connection with acetate of lead. Thus, we may add this salt with propriety to an eyewash of mucilage of sassafras pith, often used in ophthalmia, while it would be incompatible with mucilage of quince-seeds, also used for the same purpose.

In *irritable* or *inflamed ulcers*, and those attended with very profuse discharges, and in *inflamed blistered surfaces*, a solution of acetate of lead may also be used, but of not more than half the strength of that employed where the cuticle is entire. In these cases, the acetate often reacts with the albumen and salts of the secreted liquid, producing a white insoluble compound. This is ordinarily of no inconvenience; but, in ulcers of the cornea, there is danger that this compound may become permanently incorporated with the tissue, forming an opaque spot, which cannot be removed. In this affection, therefore, the salt should not be used.

Administration. Acetate of lead may be given in pill or solution. The pill is best made with mucilage of gum arabic and syrup, as these are not incompatible with the salt. It should be prepared as wanted for use. Opium is often combined with the salt; and, though mutual decomposition may take place between the meconate of morphia and acetate of lead, no practical disadvantage results. Nor is the addition of the vegetable astringents improper, as the resulting tannate of lead is efficient. When the salt is given in solution, the preparation is rendered more elegant by the addition of a few drops of acetic acid, or a little distilled vinegar; but Dr. Thomson was mistaken in thinking that the poisonous effects of the lead could in this way be prevented. Colica pictonum has followed the use of the acetate thus protected. Indeed, it may be considered nearly certain that the salt is always decomposed in the stomach, whether given with or without a little acetic acid. Laudanum renders the solution turbid by the formation of meconate of lead; but its efficiency is not impaired. The other incompatibles before referred to (see *page* 156) should be avoided in connection with the salt in solution, though many of them may be given with it in the pilular form.

The *dose* of acetate of lead is from one to three grains, which, in acute cases, may be repeated every hour, two, or three hours, and in chronic cases, three or four times daily.

In the form of *ointment* or *cerate*, the acetate of lead may be employed as a dressing for irritable or inflamed ulcers, excoriated surfaces, and blisters, and may be prepared by thoroughly rubbing together half a drachm of the salt very finely powdered, and an ounce of simple ointment; but the cerate of the subacetate is preferable, for the purposes mentioned.

II. SOLUTION OF SUBACETATE OF LEAD.—LIQUOR PLUMBI SUBACETATIS. *U. S., Br.—Goulard's Extract.*

This is made by boiling litharge or protoxide of lead with solution of acetate of lead, and filtering.

It is a solution of diacetate of lead, consisting of one equivalent of acetic acid and two of protoxide of lead.

Sensible and Chemical Properties. The solution is a colourless liquid, of a sweetish and astringent taste, of the sp. gr. 1.267 as prepared by the U. S. process, and of an alkaline reaction. Exposed to the air, it absorbs carbonic acid, forming the carbonate of lead, which is deposited at the bottom and on the sides of the vessel. Its constituents are known by the same tests as those of the neutral acetate, from which it is distinguished by forming a heavy white precipitate with solution of gum arabic, which is not affected by that salt, and by being more copiously precipitated by carbonic acid.

Incompatibles. These are the same as those of the neutral acetate, with the addition of pure gum arabic, and certain mucilages, as those of sassafras pith and flaxseed, which are strongly precipitated by the diacetate, while, though in some degree affected by the neutral salt, they are scarcely sufficiently so to be incompatible with it. Gum *mezquite*, brought into notice some years since by Dr. Shumard, as a product of New Mexico, though strongly resembling gum arabic in many of its properties, does not, according to Professor Procter, yield a precipitate with the solution of subacetate of lead.

Medical Properties and Uses. This solution has all the effects on the system of the other preparations of lead, but in this country and Great Britain is seldom if ever given internally. In France, it has been prescribed by M. Boudin, with some success, in the vomiting of epidemic cholera.

Its local effects are the same as those of the acetate, but probably somewhat more intense. In France, it is much employed for all the purposes for which the acetate is used locally with us; for example, as a collyrium in ophthalmia; as an injection in morbid discharges from the nostrils and ear; as a mouth-wash and gargle in different forms of angina and stomatitis; as an enema in chronic mucoid or purulent discharges from the rectum, with or without ulceration; and as a topical remedy in leucorrhœa and gonorrhœa. I have long been in the habit of using acetate of lead, by injection, in cases of acute dysentery affecting especially the rectum. M. Barthez has successfully used the solution of the subacetate in the same way; and the practice has been extended to acute diarrhœa and epidemic cholera, with satisfactory results. Vast quantities were injected, largely diluted with warm water, without any unpleasant constitutional effect; the liquid producing its local impression upon the mucous membrane, but not being retained long enough to be largely absorbed. M. Barthez administered at first somewhat more than a drachm in 100 times its weight of water; but afterwards increased the quantity to one, two, and even three ounces in one injection, without poisonous effects.* (*Trousseau et Pidoux.*)

In this country, the use of the solution of subacetate of lead is confined chiefly to superficial inflammations, either of the skin, the subcutaneous cellular tissue, the lymphatic glands, the tendons and aponeuroses, or the more superficial vessels, whether absorbents or veins. In the inflammation of sprains, bruises, wounds, etc.; in the more inflammatory states of certain cutaneous eruptions, as erythema, erysipelas, eczema, herpes, and impetigo; in burns, blisters, and excoriations; and in various ulcerative affections attended with irritation, inflammation, excessive secretory discharge, or hemorrhage; it may be used as an antiphlogistic, astringent, anodyne, or hæmostatic. For the purposes above mentioned, the preparation is usually employed very much diluted, as in the form of the officinal diluted solution.

In France, it has recently been recommended, in very strong solution, in mercurial salivation; not less than a sixth, or an eighth part being used in the mouth-water or gargle employed; and a preparation of equal strength is recommended in leucorrhœal discharges, especially connected with superficial ulceration of the neck of the uterus, being applied by means of a sponge or roll of linen saturated with the liquid.

---

* The sp. gr. of the present French preparation is 1.32, while that of the U. S. Pharm. is 1.267; so that the former is considerably stronger than the latter.

Great success has been claimed, in the treatment of the inflammation and fungous growth connected with inverted nail, for the solution of subacetate of lead, applied by separating the nail from the flesh, and every hour, two, or three hours, dropping into the vacant space two or three drops of the liquid; the parts in the mean time being covered with a pledget of raw cotton wet with the same liquid, and the cotton changed every day.

The following are preparations of the solution now under consideration.

1. DILUTED SOLUTION OF SUBACETATE OF LEAD.—LIQUOR PLUMBI SUBACETATIS DILUTUS. *U. S.*, *Br.*—*Lead Water.*

This dilute solution, usually called *lead water*, is at present made by adding three fluidrachms of the strong solution to a pint of water. The carbonic acid in the water causes some turbidness in the diluted preparation, which does not, however, interfere with its virtues. The strength of the diluted solution may often be much increased with advantage; and from half a fluidounce to a fluidounce may be employed to each pint, with perfect impunity, when the cuticle is unbroken. Local paralysis is stated in the books to have resulted from its use; and, though this must be extremely rare, as I have never witnessed nor heard of a well-authenticated case of it, still some caution should be exercised in applying the solution to abraded surfaces. It may be applied by means of linen cloths, or in the form of the cold poultice, as the solution of acetate of lead.

2. CERATE OF SUBACETATE OF LEAD.—CERATUM PLUMBI SUBACETATIS. *U. S.*—UNGUENTUM PLUMBI SUBACETATIS. *Br.*—*Goulard's Cerate.*

This consists of the solution of subacetate of lead, incorporated with wax, olive oil, and a very little camphor. It is an excellent preparation, admirably calculated to produce the local effects of lead, in cases in which the cuticle is wanting. Irritable, inflamed, and painful ulcers are often relieved by it; while by its astringency it favours desiccation in those which are copiously suppurating, and disposes the loose and flabby to take on the healing process. In blisters, burns or scalds, chilblains, intertrigo and other forms of superficial abrasion or excoriation, herpetic, eczematous, and impetiginous eruptions with serous or puruloid discharge, and a similar condition in lichen agrius and other cutaneous affections, it is one of the best applications that can be made. I know nothing equal to it as a dressing for blisters indisposed to heal. In many instances, and particularly in the one last mentioned, it may be combined at first with an equal weight of simple cerate. The caution should always be observed not to employ it in a rancid state, in which it becomes irritant. Hence it should be made with perfectly sweet oil, and used as fresh as possible. It is sometimes combined with opium, or calomel, or both, as an application in skin diseases of a local character.

3. SOAP CERATE.—CERATUM SAPONIS. *U.S.*

This was made, according to the Pharmacopœia of 1850, by boiling the solution of subacetate of lead with soap, and, after due evaporation, adding wax and olive oil. The process yielded a fine white cerate, capable of being spread by a knife upon linen or muslin. The present Pharmacopœia prepares it by melting lead plaster with wax, and adding olive oil to the mixture. Soap cerate is a mild sedative and desiccant preparation, applicable to similar purposes with the preceding, and employed in scrofulous swellings, and other external inflammations.

III. CARBONATE OF LEAD.—PLUMBI CARBONAS. *U. S., Br.* —*Cerusse.*—*Cerussa.*—*White Lead.*

White lead is made either, 1. by the reaction of the vapour of vinegar, and exhalations from decomposing stable manure, upon coiled plates of lead, or 2. by passing carbonic acid through a solution of subacetate of lead. Its composition is somewhat different according to the mode of preparation. The neutral carbonate, made by double decomposition between a soluble salt of lead and an alkaline carbonate, consists of one eq. of acetic acid, and one of protoxide of lead; the white lead of commerce is generally believed to be a compound of this neutral carbonate with variable proportions of hydrated oxide of lead.

Sensible and Chemical Properties. Carbonate of lead is in the form of a white powder or pulverulent lumps, heavy, inodorous, and nearly tasteless, insoluble in pure water, very slightly soluble in water containing carbonic acid,* dissolved with effervescence by nitric acid, blackened by sulphuretted hydrogen, reduced by heat to the yellow protoxide, and by heat with charcoal to the metallic state.

Impurities. The commercial carbonate of lead is very often adulterated; the most common impurities being sulphates of lime, baryta, and lead, and carbonate of lime.

Effects on the System. This salt, in consequence of its insolubility, is less apt than the acetates to irritate or inflame the alimentary mucous membrane; but it more readily affects the system at large, and is supposed by some to be the most noxious of all the preparations of lead. This proneness to act on the system may possibly, as suggested by Dr. Christison, be owing to the disposition which, from its weight and insolubility, the carbonate of lead has to adhere to the membrane, so that it is not carried off with the contents of the bowels, and is more exposed to absorption.

---

* To test the solubility of carbonate of lead, the following experiment was performed at my request by Professor Procter. A solution of neutral acetate of lead was precipitated by carbonate of potassa, and the carbonate of lead thus obtained was thoroughly washed. This was introduced into a bottle containing carbonic acid water, which was instantly corked. After standing for twelve hours, with occasional agitation, the liquid was filtered, exposed to the air so as to allow that portion of the carbonic acid to escape which had been retained by pressure, and subsequently boiled so as to drive off the remainder. No appreciable deposition took place, nor was the liquid affected by iodide of potassium; but when a current of sulphuretted hydrogen was passed through it, the liquid was perceptibly darkened, and upon standing deposited a minute quantity of sulphuret of lead. This experiment proves that carbonate of lead is appreciably dissolved by water impregnated with carbonic acid, and is retained by the water after the carbonic acid has been driven off by heat.

Medical Uses. Carbonate of lead is never given internally. Externally, it is employed as a desiccant and antiphlogistic application. Some recommend it to be sprinkled in the state of powder upon excoriated surfaces; but it should be used in this way with caution. I have known it, sprinkled thickly upon an abraded surface on the leg, to produce severe inflammation, with much pain and swelling, and a superficial slough. There is some danger, too, from its absorption; for a case is on record in which death in a child resulted from the external use of the medicine. The best method of application is in the form of an ointment (UNGUENTUM PLUMBI CARBONATIS, *U. S.*, *Br.*), which is made by rubbing up eighty grains of very finely powdered carbonate thoroughly with a troyounce of simple ointment, previously softened by a gentle heat. In this way it may be used in ulcers, burns and scalds, excoriations of different kinds, and irritating cutaneous eruptions. A liniment, formed by mixing it with flaxseed oil to the consistence of cream, has been particularly recommended in burns. A case is reported by Dr. Kunkler, of Madison, Indiana, in which colica pictonum occurred in consequence of the application of carbonate of lead, in the form of common white paint, to an extensive scald of the arm; but this effect is very rare. (*N. Am. Medico-chirurg. Rev.*, i. 605.)

IV. NITRATE OF LEAD.—PLUMBI NITRAS. *U. S.*

This is made by direct combination of litharge and nitric acid. It consists of one equivalent of protoxide of lead and one of nitric acid, without water.

Sensible and Chemical Properties. Nitrate of lead is in white, nearly opaque, four or eight-sided crystals, inodorous, sweet and astringent to the taste, permanent in the air, soluble in water and alcohol, and characterized by evolving nitrous vapour when heated, and by yielding a white precipitate with ferrocyanide of potassium, a yellow one with iodide of potassium, and a black one with hydrosulphate of ammonia.

Effects on the System. So far as known, these are the same as those of the other soluble salts of lead.

Therapeutic Application. Nitrate of lead was long since employed as an internal remedy in asthma, epilepsy, and the hemorrhages; but it is now almost entirely out of use, having been superseded by the acetate.

As it possesses the property of decomposing hydrosulphuric acid and the hydrosulphates, it corrects fetid odours dependent upon these substances, and may be employed with that object. Hence it is occasionally sprinkled in the chambers of the sick, and added to offensive discharges to obviate their smell. For this purpose, a solution may be employed containing a drachm in every fluidounce of water. *Ledoyen's disinfecting liquid* is of this nature. But, though it will correct offensive odours, there is no proof that it will prevent putrefaction, or decompose and render innoxious contagious effluvia, or the malaria of marshes. It should, therefore, never be depended on as an antidote to these noxious agents.

Having, with the corrective property above referred to, the desiccant and sedative powers of the saturnine preparations generally, it may be employed, with reference to both, as an external application, in offensive ulcers, and fetid discharges from the nostrils, ears, vagina, and uterus. To these purposes it has been applied by Dr. Ogier Ward, who uses it also in gleety discharges from the urethra, and in chronic impetiginous affections. He employs, however, an extemporaneous preparation, made by dissolving one scruple of carbonate of lead in as much diluted nitric acid as may be necessary for the purpose, and adding this to a pint of distilled water. It may be applied two or three times daily. In the more obstinate cases, a much stronger solution may be used with impunity. On the continent of Europe, a solution, containing ten grains of the nitrate in a fluidounce of water, has been advantageously employed in sore nipples, chapped hands, cracked lips, and various excoriations.

The dose of the nitrate, for internal use, would be from one-quarter of a grain to a grain, to be repeated, in acute cases, every two or three hours; in chronic, two or three times a day.

V. IODIDE OF LEAD.—PLUMBI IODIDUM. *U. S.*

This is made by mutual decomposition between iodide of potassium, and nitrate or acetate of lead in solution; the resulting precipitate being washed with distilled water. It consists of one equivalent of lead and one of iodine.

Sensible and Chemical Properties. It is a yellow, heavy, inodorous, and nearly tasteless powder, soluble in somewhat more than 1000 parts of cold water, and about 200 of boiling water, soluble also in alcohol, fusible and volatilizable by heat, yielding vapours at first yellow, but ultimately violet from the disengagement of iodine. It should be kept excluded from the light.

Medical Effects and Uses. Its effects are probably identical with those produced by the other preparations of lead. The preparation has been supposed to produce also the effects of iodine, and, under this impression, has been given in tuberculous affections, but with little advantage. In scrofulous and syphilitic swellings of the absorbent glands, both external and internal, and in obstinate ulcers, it is said to have proved useful, given internally, and applied locally, at the same time. The dose is from one to four grains three times daily. Dr. O'Shaughnessy gave ten grains without inconvenience, and even thirty grains have been prescribed. Externally it is used in the form of an ointment, made by rubbing one drachm with an ounce of lard.

VI. SEMIVITRIFIED OXIDE OF LEAD.—OXIDE OF LEAD. —PLUMBI OXIDUM. *U. S.*—LITHARGYRUM. *Br.*—*Litharge.*

Litharge is prepared by exposing melted lead, at a high temperature, to a current of air from a pair of blast-bellows, which blows off the oxide formed on the surface of the metal into a recipient, where it solidifies in minute scales. It is a protoxide of lead, containing one equivalent of lead and one of oxygen.

Sensible and Chemical Properties. This oxide is in small, shining scales, of a yellowish colour usually tinged with red, inodorous and tasteless, fusible and at a high temperature volatilizable, and reducible by heat with charcoal to the metallic state. For practical purposes it may be considered insoluble, though it is said that one part is dissolved by 7000 parts of water. It is wholly dissolved by dilute nitric acid, and is blackened by hydrosulphuric acid. On exposure to the air, it slowly absorbs carbonic acid, and therefore usually contains a little carbonate of lead.

Effects on the System. Litharge is capable of producing the peculiar effects of lead upon the system, whether taken into the stomach, or inhaled, in the state of vapour or of powder, into the lungs. But it is never used internally. Locally it has the ordinary sedative properties of the metal.

Medical Uses. It has sometimes been used, sprinkled, in fine powder, on the surface of ulcers; but its almost exclusive employment at present is as an ingredient in various officinal preparations, for which it is very important. I shall notice here those which are considered under no other head.

1. LEAD PLASTER.—EMPLASTRUM PLUMBI. *U. S.*—EMPLASTRUM LITHARGYRI. *Br.*—*Litharge Plaster.*—*Diachylon.*

This is made by boiling litharge, olive oil, and water together, over a slow fire, until they concrete into a plaster. According to the views now generally received, olive oil consists of two fatty acids, the oleic and margaric, combined with the oxide of a hypothetical radical denominated glyceryle. During the process the oxide of lead unites with these acids, and the oxide of glyceryle takes an equivalent of water to form glycerin, which is in great measure separated by kneading under water. The plaster is, therefore, oleate and margarate of lead, probably with a little unseparated glycerin, which is useful by giving it more plasticity. As kept in the shops, it is in cylindrical rolls, of a grayish or yellowish-white colour deepening on exposure, brittle when cold, but softening and becoming adhesive by a very moderate heat.

This preparation is much employed as the basis of other plasters, but is also itself highly useful as a direct application to the skin. In excoriations and slight superficial wounds and sores, it promotes healing by its sedative property, and by protecting them from the air. To guard surfaces against friction and pressure, and thus to prevent bed-sores, it is one of the best applications that can be made. Surgeons sometimes employ it to keep the edges of wounds in contact, and for strapping the leg in ulcers of that part, when bandaging is employed in their treatment. For these purposes its freedom from all irritant properties peculiarly adapts it; but it is not sufficiently adhesive without some resinous addition, and should, therefore, be used only when the skin is peculiarly delicate. It may be spread on leather, linen, or muslin.

2. RESIN PLASTER.—EMPLASTRUM RESINÆ. *U. S., Br.*—*Adhesive Plaster.*

This is made by melting lead plaster and resin together. The British Pharmacopœia adds a little soap, which renders the plaster more pliable, and less apt to crack in cold weather. It is the common adhesive plaster of the shops, much used for keeping the surfaces of wounds together, and as a dressing for ulcers by gently compressing them, and gradually approximating their edges. It is usually kept in the shops, already spread, by means of a machine, upon muslin cloths. As it becomes less adhesive by exposure, the fresher it is when used, the better.

3. SOAP PLASTER.—EMPLASTRUM SAPONIS. *U. S., Br.*

This is made by incorporating soap with the lead plaster. It is a very mild preparation, sedative, and supposed to be discutient, and hence employed in chronic swellings and indurations, spread usually upon leather.

◆

A few other preparations of lead are noticed by authors; but they are little employed, and probably capable of producing no effect, which could not be as well, or better obtained from some one of those already referred to. Among them may be mentioned the *chloride*, *saccharate*, and *tannate of lead*, of which an account may be seen in Pereira's Materia Medica; and of the last in the twelfth edition of the U. S. Dispensatory. *Tannate of lead* may be made with great facility by adding a solution of acetate of lead to infusion of galls or oak bark. It is used exclusively as a local application, and for this purpose may be incorporated with glycerin. It may be used in excoriations, as a resolvent in strumous swellings, and, in the form of ointment, as a dressing for bed-sores, and gangrenous ulcers.

◆

Besides Alum and the Preparations of Lead, there are several other mineral substances which are decidedly astringent; but all of them have other properties, more important, and for which they are more employed; and it is deemed best, in order to give due prominence to these properties, and at the same time to avoid repetition, to classify them with those medicines with which they agree in their greatest efficiency, and to treat of their astringent qualities incidentally. Such are especially the *sulphates of iron, zinc,* and *copper,* and, in a less degree, *other preparations of the same metals, nitrate of silver, corrosive chloride of mercury, sulphuric acid,* and *lime.* (See *Tonics, Alteratives,* and *Antacids.*)

CLASS II.

TONICS.

Tonics are medicines which moderately and somewhat durably exalt the vital actions. They promote the appetite, invigorate digestion, render the pulse fuller, stronger, and sometimes more frequent, raise the temperature of the body, augment in some degree the various secretions, give increased firmness to the muscles, and probably operate also on the nervous centres, especially those of organic life, somewhat elevating, though not always observably, the various functions over which they preside. It is not pretended that all these effects are produced by every tonic medicine, or by any one of them at all times, and under all circumstances. It will, however, I think, be generally admitted that, as a class, they operate as above stated upon the system in health.

They differ from astringents in the universality of their action. The latter affect the single vital property of organic contractility; and whatever other effects they may produce result from their influence upon this. Tonics operate not only on the vital contractility, but upon all the other vital properties, and may be said to be universal excitants to the functions. But this very diffusiveness of action prevents a concentration of their influence on any one function; and consequently their power of producing contraction of the tissues is much less obvious than that of the astringents.

A notion formerly prevailed that strength depended on a certain rigidity, tension, or *tone*, as it was called, of the living fibres, and especially of the muscular; and medicines calculated to increase the strength were supposed to do so by increasing this tension or tone of the fibres, and hence were denominated *tonics*. But views so mechanical as this are now no longer tenable. There may be a certain physical tension of the muscles, tendons, and ligaments, resulting from mere position; but this has nothing to do with vital force, and an increase of it will not increase the general strength. The arteries have an elasticity which, under the pressure of the heart's action, permits a tensive expansion of their coats; and a diminution of this property might lead to a defective condition of the circulation. We may even conceive that, in case of diminished elasticity, tonics might have some effect in restoring it by improving the nutrition of the tissue; but the remedy would not in this case act immediately upon the physical property, but only secondarily through the vital functions.

It is true that there is a certain vital cohesion of the living molecules, in every highly organized tissue, which is essential to the due performance of its office; and a moderate augmentation of this vital cohesion may give increased energy to the function; but this is very different from the physical property of tension. The muscles possess this kind of cohesion in common with the living tissues generally; but the strength of the system is not more dependent upon its due state in these than in other structures, and probably much less than in some others, as the nervous centres, and the mucous coat of the stomach. If, therefore, we admit the existence of tension or tone in this modified sense, and that tonics may act by increasing it, still, it does not follow that this class of medicines operates exclusively, or even mainly, on the muscles.

In the present state of our knowledge, it is best to throw out of view the origin of the terms tone and tonic, and to consider that, by the former, is expressed simply the vital power by which the several constituents of the body are enabled, under the influence of the proper excitants, to perform their function duly; and, by the latter, the means calculated moderately to elevate the several functions, by causing an increase of this power, or an increased exertion of it.

In order to estimate properly the operation of this class of medicines, it is necessary to discriminate between strength and action. The former is obviously the capacity to act, the latter the exercise of that capacity. By increasing the latter, we do not necessarily increase the former. Tonics do not, therefore, essentially augment strength, and the name of *roborantia* or *corroborants*, by which it has been proposed to designate them, is not appropriate. In a state of perfect health, they cannot be said, in any degree, to increase the vital force or strength. I conceive that the greatest strength of system is that which enables it to perform all its functions in the best manner, and to offer the firmest resistance to all disturbing agencies, of whatever kind, whether excitant, depressing, or perverting. It is in perfect health that this condition is presented. If any function, or any number of functions are exalted, either from a peculiar state of the power, or a peculiar application of excitant agency, beyond the healthy medium, the system generally, instead of being stronger, that is, better able to perform all its offices justly, and to resist noxious influences, is, in fact, upon the verge of disease, and may be brought into that state by causes, which, in its healthy condition, would not affect it injuriously. In health, therefore, tonics are not strengthening.

They may be, indeed, and not unfrequently are indirectly debilitating. They are ranked among the permanent stimulants; but this epithet is only relative. No stimulant is or can be permanent. The excitability of living parts, in other words, their susceptibility to excitant impressions, is limited. If called into excessive action, it is proportionably exhausted; and, in this state of exhaustion, the ordinary healthful excitants have less than their normal effect. Depression, therefore, necessarily follows stimulation. This is obvious in the use of powerful stimulants; but it is no less true of tonics; though, in the use of these, as the excitation is more moderate and more slowly induced, the subsequent depression is less in degree and longer delayed. By a constant repetition of the stimulant, we may sustain the excess of action longer; but the result is obtained at the expense of the excitability, which is sooner or later still more exhausted, and may at length be so much reduced that the stimulus ceases to be felt, and depression occurs even under its continued use. This depression can be counteracted only by increasing the amount of the stimulus; but the same penalty is inevitably exacted; and in the end excitability is worn out altogether, and function ceases. It may be said, however, that excitability is not strength, and, consequently, that the latter does not necessarily diminish with the former. This is to a certain extent true. But the strength of an organ, or its power to act, depends on its due nutrition, on the steady repair of its losses by the assimilation of new material, on the maintenance in fine of its normal state of organization. Now, if its excitability is permanently impaired, it cannot feel duly the influence of the materials essential to its repair, and they cannot, therefore, be suitably appropriated. Its nourishment fails, its structure is impaired, and consequently its ability to perform its function is diminished. This is debility. It follows that a constant use of tonics not only exhausts excitability, and secondarily depresses function, but positively debilitates the system.

Other evils arise from the abuse of these medicines. Allowing that they act equally on the whole system, and equally elevate all the functions, they of course promote digestion, increase the quantity and stimulant quality of the blood, augment the nutrition of all the organs, and thus put the system into a state in which, from its universal exaltation, a slight irregularity may cause the excess of excitement to fall, with an overwhelming force, on some important organ, and thus seriously endanger health, if not life, before the compensating provision of impaired excitability has had time to come into play. But supposing, as generally happens, that the tonic operates with especial force on some one organ, or series of organs, the constant excitement sustained in it attracts an excess of blood and of nervous influence, which may in the end occasion inflammation. When the stimulation is powerful, the resulting inflammation may be acute; but, as resulting from tonics, it is generally chronic.

Thus, the abuse of the medicine may lead in the end to general debility, and at the same time chronic inflammation of particular organs; a complication which it is difficult to treat, and which can, in fact, be treated successfully only by withdrawing the cause, either abruptly or gradually, and trusting to the recuperative powers of the system.

The principles above stated are strongly illustrated by the results of the abuse of the *Portland powder*, formerly much employed in the treatment of gout. This powder consisted of a combination of vegetable bitters and aromatics, and was to be taken continuously for two years, at the end of which time a permanent cure might be expected. Dr. Cullen states that the cases of nine or ten persons had come under his knowledge, who took the remedy the required length of time, having previously been subject to regular attacks of inflammatory gout yearly, or twice a year. After a longer or shorter continuance of the remedy, they had missed the paroxysms, and, at the end of the two years, were entirely free from them, and had no attack afterwards for the remainder of their lives. But in every instance their health was impaired; they were much troubled with dyspeptic and nervous disorder, and lowness of spirits; and, in less than a year from the completion of the course, without exception, they began to exhibit dropsical symptoms, which gradually increased, in the form of hydrothorax or ascites with anasarca, and in two or at most three years proved fatal (*Cullen's Mat. Med.*) It is not difficult to explain the result in these cases. The constant use of the stimulant impaired and finally exhausted the excitability of the system; debility with anæmia ensued; and with these were probably combined chronic visceral inflammation, especially of the stomach, liver, and heart, resulting from the sustained irritation of the medicine, and the superadded irritation of the gout, invited from an external to an internal seat.

It is inferrible from the above course of reasoning, the correctness of which has been abundantly confirmed by experience, that tonics should never be given in a state of sound health with the hope of increasing strength, nor for too great a length of time even in diseased conditions, in which they may have been originally indicated, for fear of inducing secondary debility and perhaps chronic inflammation.

But, nevertheless, these remedies are of great value in various conditions of *depressed and torpid function* and *debility*. It may be said that here also, as well as in health, the principles above developed are applicable; and that the ultimate effect ought to be, by an impairment of the excitability, still further to depress and weaken the system. It can, however, be shown that this is not a legitimate deduction.

1. It has been stated that the characteristic office of tonics is moderately and somewhat durably to increase the vital actions. Their first direct effect, therefore, in depressed function, is to obviate this condition. As strength consists in the normal state of the ultimate organic constituents of the tissues, which can be sustained only by a due degree of all the vital processes which contribute to the nutrition or maintenance of

parts, and tonics have the property of stimulating these processes, it follows that, when they are deficient, and debility has ensued as a result, tonics may prove not only stimulant but positively strengthening, provided the depressing causes do not outlast the excitability of the part or parts affected. Let us apply this principle.

In numerous diseases, there is a depressed condition of function, with or without positive debility, which depends upon a cause either essentially temporary or removable. Such a condition exists, for example, in low states of fever of a typhoid character, in which a depressing poison is probably acting upon the system, and in the suppurative stage of inflammation, and in gangrene, in which the strength is exhausted by copious discharge, or prostrated by the sedative influence of the mortification. In either of these cases, life may be in imminent danger; but, as the operation of the cause is temporary, if the vital functions can be sustained until this ceases or is removed, the patient may be saved. Tonics may afford the support requisite for this purpose. They excite the depressed functions, and strengthen by due nutrition the debilitated structures; and, long before the excitability, through which they operate, has had time to suffer materially from the stimulus, the cause ceases, and the system is left in a condition in which it can repair itself.

2. We not unfrequently meet with cases of depression and debility, continuing after the cause has ceased. The system, or a part of it is, as it were, left paralyzed. It seems as though a habit of insufficient action had been established, which the inherent force of the system could not throw off. Living, like dead matter, has a sort of *vis inertiæ*, which disposes it to continue in any condition in which it may have compulsorily continued for a considerable time. Under these circumstances, a little gentle stimulus serves to rouse it out of its torpor; and once again fairly in action, it will go on without further aid. As a watch stopped in the winding, and continuing quiescent, will resume its accustomed motions with a little shaking; so the system, reduced by disease, and remaining torpid after the disease has ceased, will react with a slight excitation, and enter again into its ordinary round of action. Tonics are often sufficient to give the requisite impulse. Hence, in part at least, their use in the torpor of system, or that of a particular organ, so common in convalescence from acute disease.

3. General depression or debility may result from the torpidity of a particular function or organ, upon which, in turn, the general deficiency may react, so as to sustain and even increase its inertness. Thus, the stomach, or the function of digestion, may have been depressed by some cause acting upon it alone. The food, of course, is not properly digested, the quality of the blood is impaired, the general function of nutrition suffers, and consequently the stomach with other organs. The disease thus runs on in a vicious circle, at each round increasing the local condition

in which the whole originated, and deepening the general debility. By moderately stimulating the digestion, we restore the due qualities to the blood and the due energy to nutrition, the stomach recovers its powers when properly nourished, and the whole evil is corrected. A like train of consequences, and a similar mode of repair, may occur in reference to any one of the great organs or functions. Tonics often operate in this method in the cure of disease.

It is seen, therefore, that numerous cases of depression and debility occur in which tonics may be useful. But they are not applicable to all affections of this kind indiscriminately.

1. That tonics may be serviceable in debility, there must be a certain amount of excitability remaining. Otherwise they may be useless, or even worse than useless. Depression and debility, resulting from exhausted excitability, cannot be repaired by tonics. In the debility of drunkards, for example, which is the result of over-stimulation, tonics, if felt at all, could produce only a slight excitement, to be followed by still greater depression; and their habitual use would only hasten the fatal issue. The only hope in these cases is in the cessation of the cause. The habit of stimulation must be abandoned, or there can be no remedy. With future abstinence, if the excitability of the organs has not been fatally impaired, and no destructive disorganization has taken place, a gradual amendment and ultimate restoration may be hoped for, under the recuperative powers of the system. The only principle upon which tonics, under such circumstances, could be used with propriety, rests on the occasional necessity of not too hastily withdrawing all support from the system, lest fatal prostration should ensue. They may sometimes be resorted to, as a feebler stimulus than the accustomed one, in order that the transition may not be too abrupt.

2. Tonics cannot be relied on when the debility results from a constantly operating and irremovable cause. They would, in such cases, generally prove injurious by their secondarily debilitating influence, and would probably lead to a more rapid exhaustion of the patient. The debility, for example, resulting from cancer cannot be repaired by tonics. They may occasionally be useful in counteracting accidental debility of some one organ, or association of organs, which may be interfering with the proper exercise of the others; but the general rule holds true.

3. Depression, amounting even to apparent prostration of the system, sometimes depends upon an active and overwhelming congestion, or extensive inflammation of some important organ or tissue, as the brain, heart, lungs, stomach, peritoneum, etc., which either concentrates so much of the blood and nervous force in one part that there is insufficient elsewhere to support the systemic actions generally, or immediately cramps the organ affected so as to arrest its function, and thus prostrate all dependent functions. In either of these cases, tonic medicines could

be of no service; the indication being by depletory measures to unload the congested organ.

4. In cases of great or sudden and transient depression, tonics are of little or no service; their action being too slow and moderate to meet the indication presented. When stimulation is required, under such circumstances, it is necessary to have recourse to the diffusible stimulants for internal use, and the rubefacients externally.

The general rule, then, in relation to the use of tonics, is that they are indicated in all cases of depression and debility, in which the excitability has not been exhausted by previous stimulation, which do not proceed from a permanent and irremovable cause, and in which the depression is neither the result of active congestion or irritation, nor so sudden and transient as to call for stimulation more prompt and fugitive than that which characterizes this class of medicines.

Of the particular diseases in which tonics may be used, all that can be advantageously said will come better under the heading of the several individual medicines; as the peculiar character of each medicine very much influences its application. It remains here only to treat of their precise mode of action, so far as that is known.

Mode of Operation. Most of the tonics probably act directly on the mucous coat of the stomach and bowels, thus stimulating immediately the digestive function; and there is reason to believe that some act chiefly, if not exclusively, in this way. It was formerly thought, and some still think, that the impression made on this surface is propagated, to a greater or less extent, over the system by means of sympathy, or the intervention of the nervous centres; and it is not possible to prove that the tonic impression is never diffused in this way. But, when it is considered how slowly the tonics act, and that many of them, particularly those of mineral origin, have been detected by chemical reagents in the blood or secretions, it seems most reasonable to suppose that those, the direct influence of which extends beyond the digestive organs, operate through the route of the circulation. The different modes of action of the different tonics may be included under the following heads.

1. I have stated that some appear to act chiefly, if not exclusively, so far as their immediate tonic influence is concerned, on the digestive organs. By promoting the appetite and invigorating digestion, they cause more food to be taken, and that which is taken to be more thoroughly prepared for absorption and assimilation. They thus enrich the blood, rendering it at once more stimulating to the functions, and nutritive to the tissues, and produce indirectly the general tonic effects upon the system at large. Such are the mineral acids, and to a certain extent the simple or pure bitters, which, though they may possibly operate directly on the system through absorption, display their effects much more obviously upon the stomach and bowels.

2. Other medicines of the class operate directly and mainly on the blood itself; not through the agency of the digestive process, but by intimate admixture with that fluid, into which they find admission, either by venous absorption, or through the lacteals or intestinal lymphatics. They may act either 1. by entering immediately into the composition of some one of the proximate principles of the blood, 2. by modifying the vital condition of its organized constituents, or 3. by favouring, through a stimulant influence on its vital properties, the physiological actions which are constantly going on within it, and thus contributing to its full development and maintenance. The blood, thus elevated in its constitution, performs its offices in the economy with more vigour, and operates with a tonic influence on all the functions. Upon this principle it probably is that the preparations of iron chiefly act; and I am disposed to ascribe the peculiar influences of cod-liver oil in disease, in some measure, to analogous modifications produced by it in the blood.

3. Most of the class probably operate directly upon the ultimate organic constituents of the tissues, entering the circulation either unchanged or more or less modified, and being distributed everywhere by the blood as a mere vehicle; though it is not impossible that they may operate also upon the vital properties of that fluid, through the same power by which they affect the similar properties of solids. How it is precisely that they affect the ultimate organic constituents of the body is conjectural. They may act merely by their presence, or they may enter into a sort of chemical union with the living matter, though I am inclined preferably to the former of these views. At all events, some of them have been found, on chemical investigation, in the midst of the tissues. It is probable that each distinct function is performed through the instrumentality of a special power in the ultimate organic cells, nuclei, or molecules of the organ, and tonics may operate simply by stimulating this power into a somewhat increased activity. But we may advance one step further, and adopt the very plausible opinion, that in all the tissues there is a certain vital cohesion which is essential to the due performance of the function, and that tonics are moderate stimulants to this cohesion. To this mode of action we may ascribe in part the greater firmness of the tissues, especially the muscles and blood-vessels; and to this perhaps also that condition of the nervous centres resulting from the use of certain tonics, by which they are enabled to exercise their proper functions more energetically, and have greater power of resistance to all kinds of disturbing influences. Such an influence is exhibited in the control evinced by some of the metallic tonics over various nervous diseases, as chorea, epilepsy, and neuralgia.

Before considering the several tonic medicines, with their [illegible], I propose to give a succinct account of various influences of a tonic character, which, though not strictly medicinal, are often very useful in disease, and must therefore rank among remedies.

---

1. TONIC DIET.

A proper regulation of the diet is indispensable to the obtaining of satisfactory results from the use of tonic medicines. Experience has established the fact, beyond controversy, that a mixture of vegetable and animal food is best suited for man. There can be as little doubt, on the score of experience, that animal food is more supporting to the system, and more stimulating than vegetable. Indeed, the effects of a relative increase of the former in the diet are not dissimilar to those produced by tonic medicines; proceeding at first from a direct excitant impression on the stomach, and subsequently from an augmented richness of the blood. A long-continued excess of animal food leads also, like an abuse of tonics, either to plethora with its dangers, or to a complication of diminished excitability with local inflammation. We may, therefore, rank the use of animal food, beyond the ordinary proportion, among tonic influences; and, when an indication exists for these medicines, there is generally a coincident indication for the kind of diet referred to.

As the main object of tonics is usually not merely to stimulate the functions, but to obviate debility by sustaining, through the process of nutrition, a due state of the organization, it is obvious that, in order to produce this effect, there must be nutrient material for them to operate with. It does not, however, necessarily follow, that the quantity or richness of the food taken should be increased; for the patient may have been in the habit of taking more than his digestive powers could manage; and the end desired is attained by a more thorough assimilation, and less waste of the nutriment, through the greater energy given to digestion by the medicine. In judging, therefore, as to the propriety of increasing the amount of food, the practitioner must take previous habits into consideration; and, if the diet should be found to have been in excess, in reference to the digestive and assimilative powers, there would be no propriety in augmenting it, at least until the balance should be restored.

The kind of food previously used must also be allowed to modify the prescription. If the diet had been exclusively vegetable, it is obvious that a relatively smaller quantity of animal food should be directed; if exclusively animal, it would be necessary, in order to obtain the same end, to employ it more freely.

Reference must also be had to the habits of the patient in relation to exercise. Food is consumed by bodily exertion, and the greater the latter is, the more will be required of the former. To produce a tonic effect, therefore, a greater elevation of the diet would be necessary in a person of active, than in one of sedentary habits.

The quality of the animal food employed is scarcely less important than its quantity. Some kinds are more stimulant, some more nutritious, and some more digestible than others. The most stimulating may produce an excitant effect greater than desired; but food can scarcely be too nutritious, or too easily digested for tonic purposes. A few words, therefore, on the more common articles of animal food, in reference to these points, may not be out of place here.

One of the lowest varieties of animal food in stimulant and nutritive properties, taking bulk into consideration, is milk;* but it is easy of

---

* *Milk Cure.* Milk has been recently raised, in Russia, almost to the dignity of a panacea. Dr. Philip Karell, "Physician to his Majesty the Emperor of Russia," in a communication to the Medical Society of St. Petersburg, after giving a history of the therapeutical use of milk by his predecessors in various parts of Europe, some of whom had most extraordinary success, proceeds to offer his own mode of treatment, in the remedial efficiency of which he seems to have unbounded confidence. He generally commences the treatment by directing *the exclusive use of milk* for nourishment, permitting no other food. He prescribes for the patient three or four times a day, at regular intervals, from two to six ounces of skimmed milk of the best quality. The whole of each dose should not be swallowed at once; but it should be taken slowly, and in small quantities, so as to be well mixed with the saliva. If the patient digest the milk well, which may be inferred if the stools before liquid become solid, the dose is to be gradually increased. For the first week the patient has great difficulty in resisting his craving; but this is removed in the second week, during which two quarts are given daily. If the case take its regular course, the milk must now be drunk four times a day, at eight A.M., at noon, at four P.M., and at eight P.M. If the patient wish, these hours may be allowed to change; but the same interval must always be observed; and on no account should he be left to his own discretion either as to the time or quantity. When the bowels become constipated, as often happens, this may be obviated by injections of warm water, or by the use of castor oil or rhubarb. Should the constipation be obstinate, a little coffee may be given every morning with the milk, or sometimes four or five stewed prunes or a roasted apple. If, at the end of the second or third week, there is a craving for solid food, a little stale bread with salt, or a small salt herring, may be allowed; and a little stale bread at the dinner-hour. Once a day the patient is permitted to take some soup made of milk and [illegible]. After five or six weeks, the milk may be given only thrice daily, and meat once a day or twice. Dr. Karell has found very little to digest the more easily [illegible] confidence on the part of the patient, and a rigid adherence to the rules given, are necessary to ensure success. The affections to which the milk-cure is applicable are dropsy with hypertrophy of heart, diarrhoea, [illegible] in the forms of ascites and hydropericardium, asthma, dyspepsia, catarrh, rheumatism, and gouty affections, nervous disorders dependent on defects in the fluids, chronic irritation of the pharynx and oesophagus, ulcers of the stomach, and similar affections of the bowels. The greater cases formed the larger portion of those successfully treated. (*Edin. Med. Journ.*, Aug. 1866, p. 97.)

Now I can bear testimony to the great efficacy of an exclusive or almost exdigestion, and may be preferred in a tonic course when the digestion is feeble, and the previous habits of the patient have been those of abstinence. The same may be said, in less degree, of its derivative *butter*. Another derivative, *cheese*, while probably not more nutritious, is more difficult of digestion, and, in consequence of chemical changes, often much more stimulating. The latter, therefore, should not be given when the stomach is feeble. Next in the ascending scale of nutritive and excitant power, are *oysters*, *eggs*, and the lighter kinds of *fish;* and these are generally easy of digestion, when properly prepared. Raw oysters, particularly salt oysters, are themselves stomachic, often exciting the appetite, generally easy of digestion, and an excellent ingredient in a tonic regimen. The eggs should be soft boiled; or, if hard, should be grated very finely so as to overcome their cohesion, and render them more easily soluble in the gastric juice. Next come the different kinds of *poultry with white flesh*, and after these the ordinary meats, as *mutton* and *beef*. The dark-fleshed poultry, as *ducks* and *geese*, and all the varieties of *pork*, are most stimulant and most difficult of digestion, and, though highly nutritious also, should be used only when the digestive powers are strong, and exercise is taken abundantly. *Wild animal food* is preferable to the same varieties *tame*, as being more easily digested. On the same score, *adult animal food* is preferable to the *very young*, which is too stringy, and less nutritive, or to the very old, which is often very tough. Beef, mutton, and fowls are preferable to veal, lamb, and chickens. *Very fat meats*, though stimulant and nutritious, are not so easily digested, and often unsuitable. *Salt meats* are less nutritious than the fresh, and also less digestible, and, though often admissible, particularly in small quantities as condiments, should be excluded, as main articles of diet, when the digestion is feeble. The mode of cooking, too, has much influence over the quality of the food. Boiling renders meats less nutritious, and therefore less suitable for a tonic diet. *Frying*, and other modes of preparation, in which butter and fats are heated with the meat to the point of decomposition, are unsuitable, in consequence of the indigestible, as well as irritant character, often imparted to the food. *Roasting, broiling, baking, and stewing* are more appropriate modes of treatment. *Soups*, which contain the extractive, gelatin, and other soluble parts

---

clusive milk diet, particularly in morbid states of the blood, and in cases of obstinate vomiting, and chronic diarrhœa; having recommended and employed this remedy, under such circumstances, for more than thirty years. In reference to the blood, I have used the remedy on the grounds of the easy digestibility of milk, and its composition, as it contains all the constituents necessary for making wholesome blood; and, in reference to diseases of the stomach and bowels, of its perfect blandness, in addition to the properties mentioned. But I am, nevertheless, indisposed to admit its claims to a position of special eminence as the milk-cure. (*Note to the third edition.*)

of meat, are more stimulant and less nutritious than solid flesh, and, though they may be employed, should never be relied on. *Meat extracts* contain the soluble parts of meat, obtained first in a liquid form, and then evaporated to a solid consistence. They are in fact concentrated soups, and when used are brought into the liquid form by treating them with boiling water.* The *essences* are too stimulating for a mere tonic course.† Whatever food is taken should be thoroughly masticated. Fresh vegetable food of easy digestion should not be excluded; for, though destitute of tonic properties, it imparts qualities to the blood which are indispensable, and without which there would be constant danger of producing a scorbutic character of that fluid. Potatoes, from their highly nutrient and antiscorbutic properties, are very useful in a tonic regimen.

2. EXERCISE AS A TONIC.

This is an invaluable tonic measure in debility. There are two kinds of exercise, which, though they produce the same ultimate effect, operate in a somewhat different manner, and are calculated to meet somewhat different indications; active, namely, and passive. *Active exercise* is that performed under the influence of the will; *passive*, that in which the will is quiescent, and extraneous influences operate. Walking, running, leaping, wrestling, rowing, and the various gymnastic movements are examples of the former; riding on horseback, driving, steaming, sailing, etc., of the latter. The two are frequently more or less combined.

---

* The noted "*extractum carnis*" of Liebig, which has the advantage of containing little gelatin, is prepared by digesting meat, finely divided, and deprived as far as possible of gelatinous and fatty matter, with twice its weight of water, at 212°, for an hour, and separating the liquid by strong pressure; again, digesting and expressing as before; then evaporating to about one-sixth; and, after allowing the residue to cool, removing the fat that congeals on the surface, and finally evaporating to the ordinary consistence of extracts. Ten pounds of meat should yield six ounces of extract. (*Pharm. Journ. and Trans.*, Oct. 1865, p. 207.)—*Note to the third edition.*

† *Raw meat.* Considerable attention has of late been paid to raw meat and alcohol as a remedy for phthisis and other cachectic affections, introduced into use by M. Fuster, of Montpellier, France, who claims to have obtained great advantages from it. For the mode of administration, see my work on the Practice of Medicine (6th ed., i. 113). According to M. Fuster, the raw meat favours assimilation and nutrition, and with alcohol has proved of great advantage in various diseases besides phthisis, as chronic anæmia, leucocythemia, albuminuria, diabetes, and typhus and typhoid fevers. How much of the virtues of the remedy depends on the rawness of the meat is exceedingly doubtful; and it is liable to this great disadvantage, that the meat may contain the germs of one of the forms of tænia, or even those of the Trichina spiralis, and if taken uncooked, may give rise to those serious forms of parasitic disease. (*Note to the third edition.*)

Thus, in the active exercise of rowing, while the muscles of the extremities are operating under the will, the whole frame is jarred by the movements of the boat; and in the passive exercise on horseback, while the body is shaken by the motions of the horse, the muscles are employed in regulating the animal, and maintaining the position of the rider. Active exercise is always primarily partial; passive is usually general, affecting every part of the body, though this is not necessarily the case in all instances; for a part only of the body may be agitated; as in that kind of exercise of the stomach recommended by Halsted in the treatment of dyspepsia, in which, the body being bent, and the hands pressed backward beneath the epigastrium, gentle and quickly repeated succussions are given to the organ by the upward movement of the fingers.

It is not difficult to explain the tonic effects of exercise. In the active variety, the cerebral centres are first stimulated; then the muscles; then the heart through the organic nervous centres; and finally all the functions indirectly, in consequence of the greater rapidity of the blood flowing everywhere through the capillaries, to which these functions are indebted for the supply at once of stimulus and material. A certain amount of exercise, varying according to the state of the individual, is requisite to support the functions in a condition corresponding with the degree of general strength. A moderate excess beyond this amount will produce only a moderate stimulation, or in other words a tonic effect; a great excess gives rise to proportional excitement, and may prove powerfully stimulant. The general laws above given, in reference to tonic medicines, are applicable to this remedial measure. In a state of debility, if the exercise be moderately increased, it will increase strength, by supporting all the organic functions, and among the rest digestion, sanguification, and nutrition. In perfect health, if urged beyond the point requisite for the sustenance of this condition, it leads to the evils before described as the result of the abuse of tonics. In either case, if used in great excess, so as to stimulate actively, it exhausts the excitability, and may thus lead to secondary prostration and debility. It is perceived, therefore, that the employment of active exercise as a tonic requires the same judgment and discrimination as that of the medicines belonging to the class. The general rule is to proportion the amount of it to the strength, and never to push it so far as to occasion secondary exhaustion. A slight feeling of fatigue may be considered as an evidence that it has been carried sufficiently far for the time.

In *passive exercise*, as a general rule, all parts of the body are excited by the agitation equably and moderately. The blood and nervous power are, therefore, invited in a nearly equal degree to the seat of every function, and a moderate diffusive tonic effect is experienced throughout the system. It may be said that, as there is only a certain quantity of blood, and a certain amount of nervous power in the body, you cannot increase these, in the system at large, through any immediate influence, and, therefore, that such a diffusive tonic effect as I have referred to is impossible. But the whole nervous power is never called into full exercise in health, and, though it cannot be indefinitely drawn upon, yet it may be so in a moderate degree, beyond the ordinary wants of the system; and its influence, therefore, may be everywhere in the same degree augmented. In reference to the blood, if the whole quantity cannot be increased, yet the rapidity of its motion may; so that a greater amount is present within a given time in all the organs. Besides, so far as concerns the smaller vessels or capillaries, where alone the blood is operative in sustaining the functions, the quantity may certainly be increased at the expense of that in the heart and great vessels, which serve mainly for its conveyance, or in the spleen, which probably often acts as a mere receptacle. It is, therefore, quite possible that all the organic functions may be moderately excited at the same time; and this, I think, is the effect of passive exercise. In consequence of the equable and diffusive character of its influence, it has an advantage over active exercise in cases of great debility. In the latter, a slight excess of muscular action may call the heart into inordinate and even dangerous excitement. Patients greatly debilitated have sometimes fallen dead, upon slight exertion, in consequence of the excessive action and consequent speedy exhaustion of the heart; and, where there is no danger of such a result, there may be liability to serious congestions, to hemorrhage, and even to cardiac hypertrophy. So also, the encephalon may be inordinately stimulated through the influence sent up to it by the excited muscles, demanding through the nervous centres a supply of blood. Again, the over-excitement of particular organs leads to deficiency of action or depression in others; as shown in the result of violent exercise taken immediately after a full meal; the powers of the system being concentrated in the muscular, and its immediately subsidiary functions, and withdrawn from the digestive, so that the food remains unacted on. In short, the influence of active exercise is necessarily more or less partial, and therefore liable to occasion local excess or deficiency of function; that of passive exercise is general, and more equable, and therefore safer when the object is to correct great general debility, especially when associated with morbid tendencies of any organ, as of the heart, which active exertion may serve to aggravate, or call into operation.

Yet passive exercise is alone insufficient; for there are certain functions, such as that of muscular motion, which can be performed only through the agency of the will, and which will suffer if permitted to remain quiescent. Though the instruments of these functions may be invigorated, so far as their nutrition is concerned, by passive exercise, yet they will not operate efficiently for their peculiar purposes unless sustained in a due habit of action. On the whole, therefore, in or [illegible] strengthen a weakened system in all points, it is advisable to combine more or less together both kinds of exercise.

Partial or local weakness may always be treated with partial exercise, whether active or passive. Thus, a limb which has become enfeebled, and incompletely paralyzed by long rest, as, for example, an arm or a leg in which the muscles have been restrained by bandaging, may be restored to its original powers by constantly repeated efforts on the part of the patient to use it; and attention has already been called to a useful method of producing passive exercise of the stomach in pure dyspepsia.

The above remarks are applicable to the mental, or purely cerebral functions as well as to the others. These may also be divided into the active and passive, the former being voluntary, as the intellectual functions, the latter involuntary, as the emotional. In debility of the active functions, it is necessary, in order to restore due vigour, to exercise them actively through the will of the patient; in that of the passive, to exercise them passively, by so regulating extraneous influences as to excite them into operation.

It may be proper, before leaving the subject, to say a few words on the several varieties of exercise most resorted to in the treatment of disease.

Modes of Active Exercise. Upon the whole, *walking* is probably the safest and most efficient mode of active exercise, in cases of simple general debility. It should be continued at one time no longer than may be sufficient to cause a slight sense of fatigue, and should be frequently repeated. The amount must, of course, be regulated by the strength of the patient. It should never, in debility, be so rapid as to induce much palpitation of the heart. When the weather is such as to forbid the invalid to walk in the open air, he should take the exercise within doors, throwing up the windows, so as to admit the fresh air, and maintaining a temperature in the apartment, somewhat below that which is comfortable to him when seated.

Other and more energetic modes of active exercise are *running, leaping, wrestling;* the various kinds of *bodily labour; athletic games*, as those of *quoits, ball-playing, bullet-rolling, bar-pitching*, etc.; and within doors, *dancing, billiards, nine-pins*, the use of *dumb-bells, battledore* and *shuttlecock, gymnastics, calisthenics*, etc. It is often necessary, in order that the invalid may be duly amused or interested, to vary the modes of exercise to suit his taste or caprices; and hence the propriety of having a considerable list out of which to choose. To those already mentioned, as suitable for patients confined to their houses, may be added, *sawing* and *splitting wood, rubbing furniture*, and various other household operations, which, by amusing the patient with the idea of usefulness, may lessen the irksomeness of the measure, considered merely in a therapeutic point of view. Indeed, this idea should be carried out in all plans of exercise. There should be some other ostensible object than that merely of improving health. The patient should, if possible, become interested in the act, occupation, or pursuit for itself alone. Other advantages of this diversity of plans are that, by a proper choice among them, we may duly proportion the activity of the exercise to the strength of the patient, and that, in consequence of the various muscles brought into play in the different methods, we may by successive changes operate on the whole system of voluntary muscles, or bring some particular method to bear upon special muscles or organs, which may stand peculiarly in need of invigoration. But in all the methods referred to, care must be taken to avoid excess; and this is particularly necessary of those which have in themselves something fascinating or seductive. Serious evils, for example, have sometimes arisen from the abuse of dancing, and gymnastic exercises.

The modes of exercise above referred to are often useful, not only by their tonic influence on the muscular system directly, and other systems indirectly, but also by a derivative influence, tending to draw away an excess of blood and nervous action from internal organs, congested or chronically inflamed. Every one of sedentary and studious habits must have been sensible of the great relief, in instances of visceral uneasiness, or oppressed and clouded thought, afforded by rising and walking briskly for some time, or otherwise actively employing the voluntary muscles; and chronic inflammation of the liver, stomach, brain, etc., may often be greatly benefited by a systematic external derivation of the same kind.

Modes of Passive Exercise. Horseback exercise is probably the most effective, and generally applicable, of all the different passive methods. It is, however, too fatiguing for great debility. Moderate at first, it should be gradually increased with the increasing strength and tolerance; and a patient who has commenced with less than a mile, may often extend his rides to fifteen or twenty miles daily with propriety. It is more especially applicable to cases in which the abdominal or thoracic viscera are enfeebled. No remedy, probably, is more effectual in pure dyspepsia; and, since the times of Sydenham, it has been considered a most valuable prophylactic in phthisis. Indeed, there is reason to think that it often proves useful, and sometimes even curative, after the disease has actually commenced. Hepatic torpor without inflammation, habitual constipation from enfeebled function, and hemorrhoidal affections arising from one or both of the preceding conditions, are often benefited by this mode of exercise. The same may be said of headaches and other cerebral affections, purely functional, and connected with debility. In relation to riding on horseback, the remark before made as to the importance of combining other objects with the pursuit of health, is peculiarly applicable. I have been told that the late Professor Wistar, of Philadelphia, used to recommend his dyspeptic patients to ride out every day to a certain chalybeate spring, several miles from the city; his object being much more the benefit of the ride than that of the waters. A long journey on horseback is an almost certain cure for pure dyspepsia.

Carriage exercise is more purely passive than that on horseback, for which, in its rougher modes, it is the best substitute. The jolting of a rough vehicle over smooth roads, or of a smooth vehicle over rough and stony roads, is often highly useful in the cases to which attention was called in the last paragraph. The jarring movement of the *railroad car*, and that of the *steamboat*, is next perhaps in efficiency to that just referred to. That of a *row-boat* is of the same character; and the exercise of the rower himself, combining the active and passive kinds, is an admirable measure for imparting vigour to the system, if not overdone. *Riding in a smooth carriage* and *sailing* are the mildest methods, applicable to the feeblest condition of system requiring exercise.

Substitutes for these methods may be found within doors. Chairs have been invented which enable the invalid to imitate horseback riding; and the same effect is in some degree obtainable by the jogging motion of an ordinary chair. The *rocking-chair* and the *swing* are partial substitutes for the smooth carriage and the sailing vessel; but, in these methods, it must be recollected that the peculiar character of the motion gives a special direction to the blood; in that of rocking centrifugally to the head, in that of swinging in like manner centrifugally from the head. From the former, therefore, injudiciously indulged in, there may be some risk of cerebral congestion; from the latter, of defective circulation in the brain.

Friction and *shampooing* may be considered as local varieties of passive exercise. Friction may be performed by the patient himself, in which case the active is combined with the passive, and more universal effects are obtained. It may be performed with the naked hand, or by means of flannel, a coarse linen towel, the flesh-brush, or any other roughish material; and should be carried so far as to excite some redness in the surface, but not to abrade or inflame it. The more extensively it is performed over the body the better; as its influence is thus proportionably generalized. It should be repeated once or twice daily in chronic cases. *Shampooing* is a practice introduced from the East, and consists essentially in a kind of kneading process, performed on the surface, but reaching in its effects deeper than mere friction, in fact throughout the soft parts of the body not protected by a bony case. *Slapping* over the surface with the sole of a slipper, or any slight flat body of a similar character, operates in the same way as the above processes. The effect of all of them is moderately to excite the surface and the soft parts near it, thereby attracting the blood and nervous action, and producing a tonic impression; while they operate derivatively in relation to the internal organs. They are, therefore, especially indicated in cases of torpor of the skin and muscles, attended with congestion or chronic inflammation of the viscera.

3. PURE AIR AS A TONIC.

This, though a very efficient tonic under certain circumstances, must be considered as acting negatively. In large towns, the atmosphere is impregnated with effluvia, the general effect of which on the system is at first depressing, and ultimately debilitating. By removing from town into country, we escape this influence; and, the cause of weakness being removed, our systems acquire renewed strength through the healthful agency of an uncontaminated atmosphere. This is especially the case with invalids, whose strength has been impaired by disease, and whose systems are often unable duly to react, while exposed to the air of cities. I presume there are few inhabitants of large towns who have not felt, even in their ordinary health, the refreshing and invigorating effect of the country atmosphere, or, to speak more accurately, of an escape from the enfeebling effluvia to which they are habitually exposed.

The sick chamber is liable, in a still greater degree than the general atmosphere of towns, to the charge of unwholesomeness; and, even in the country, therefore, invalids are often greatly benefited by escaping from the confined and sedative air of their lodgings to that of the open fields.

These remarks, while applicable to debility in general, are peculiarly so to that of convalescence.

But, though pure air may be only negatively tonic at the ordinary atmospheric pressure, yet, by exposure to the atmosphere either much rarified or much condensed, a tonic influence on the respiratory organs is obtained, in the former case indirectly, in the latter directly, from which much good may be expected in debilitated conditions of those organs.*

---

* From observations by Dr. Hermann Weber on the climatic influence of the high regions of the Swiss Alps, he came to the following conclusions.

Respiration is increased in frequency and depth, with increasing elevation.

The heart contracts more frequently in proportion to the height attained.

The appetite, and generally thirst, are augmented.

Sanguification is improved.

The nervous system is invigorated, and the sleep more healthy.

The muscular system acquires increased energy, and is more active.

It is inferred that the metamorphosis of tissue is augmented; though the urine does not appear to be materially altered in quantity; the proportion of solids being

4. MENTAL INFLUENCE AS A TONIC.

Certain states of the mind are known, from experience, to have a sedative effect upon the system at large. Grief, anxiety, and all the various modifications of fear are distinguished, in common nomenclature, as the depressing emotions. Whatever, therefore, in any manner counteracts or removes these feelings, must be indirectly stimulant; and, even though purely negative in its operation, would rank among tonic influences. But there are also mental conditions which have a directly elevating or supporting effect. The more refined pleasures of sense and perception; the appreciation of the beautiful, the picturesque, or the sublime in nature and art; the enjoyment attending the legitimate exercise of all our intellectual powers; the pleasurable emotions of love, hope, confidence, joy, of triumphs over difficulties, of temptations resisted, of a legitimate ambition gratified; all these produce in our physical systems an excitation, which, though, like stimulation from any other source, it may be excessive and injurious, is more generally within the limits of a healthful influence, and, in states of debility, is positively tonic and restorative. No practitioner can fully perform his duty towards his patients, who does not avail himself of this instrumentality in cases of debility. It is probably more available, in the treatment of defect of function in the digestive organs, the liver, and the brain, than in pure general debility; as it is upon these functions especially, that the opposite condition of mind exhibits most obviously its depressing tendencies.

5. TRAVELLING AS A TONIC.

This agency is merely a combination of those already treated of; but it affords so ready and efficient a method of obtaining their conjoint influ-

---

only probably somewhat increased. (*Dublin Quart. J. of Med. Sci.*, Feb. 1, 1864, p. 42.)

Compressed Air as a Remedy. Dr. de Vivenot has ascertained, by a series of experiments, that by exposure daily to the influence of compressed air, as in a diving machine for example, the capacity of the lungs becomes enlarged. This increase of capacity amounted in himself and others, after a daily exposure for an hour or two, continued for three months, to the compressed air of a chamber, to 3·36 per cent., or about one-thirtieth of the whole capacity of the lungs. Nor was this condition transitory, as the augmentation was found almost undiminished a month after the cessation of the experiments. To this enlarged capacity was added an increase of elasticity of the pulmonary tissue, and of the power of the respiratory muscles. The surface, moreover, of the air-cells is brought into contact, in a given time, with a greater amount of air. Great therapeutic advantages might be expected from this kind of tonic influence, which is especially applicable to cases of emphysema, atelectasis, tuberculosis, dyspnœa from pleuritic exudation, etc. (*Arch. Gén. de Méd.*, Nov. 1865, p. 611.)—*Note to the third edition.*

ence, that it merits a distinct notice. Exercise steadily maintained, pure air, and a favourable mental condition, are the real tonic agents which give to travelling the powerful curative influence exerted by it in affections complicated with, or essentially consisting in debility, whether of the whole system, or some one or more of its parts. But, to be useful, it must be properly conducted. To jump into a railroad carriage, or a steamboat; to be whirled in crowds from point to point, with headlong rapidity; to lodge in densely thronged hotels, and swelter all the night in close apartments; to be ever on the anxious watch for a good position, or any position at all, in the immense competition of the masses; to eat hurriedly anything which is set before you, and at times adapted not to your own convenience, but to that of the transporting party; often, in the onward rush, to pass nights without sleep, or with insufficient sleep, upon the road or the stream, and in an atmosphere contaminated with human exhalations; this is not relaxation and amusement; it is labour, often very fatiguing, vexatious, and exhausting labour; and it is no wonder that invalids, who travel thus, return weaker than when they started, and with very discouraging impressions as to the remedial virtues of travelling. All this should be reversed. There should be no hurry, no bustle, no anxiety or struggle. Arrangements should be made for quiet movement on foot, in a carriage, on horseback, or in two or more of these methods successively. The lodgings should be comfortable and airy, and a due amount of sleep procured. The meals should be taken as regularly as possible, eaten slowly, and of wholesome food. With a little care and forethought in regulating these points, the happiest effects may be hoped for. The charms of rural scenery and rural sounds, the frequent novelties, the succession of interesting incidents, the changing personal intercourse, the sweetness of repose after moderate fatigue, light and agreeable reading in the intervals of rest, the various gratifications of the passing day, the as varied hopes and plans for the morrow; perhaps a short sojourn in some way-side inn, .with charming scenery and cool shade without, and cleanliness, neatness, and a cordial welcome within; perhaps a longer abode in some place of more general resort, by the sea-shore, or near some mineral spring, for example, where salt-bathing or chalybeate waters may superadd their tonic effect to that of cheerful social intercourse; all these genial influences combine, with the sustained exercise and uncontaminated air, to elevate and support the physical functions, and often serve to restore energy to a debilitated frame, upon which medicines have been tried in vain. In the debility of convalescence; in that resulting from an overstraining of the mental and corporeal functions in the eager pursuits of business or ambition; in various chronic inflammations of the internal organs, in which the local mischief is sustained by a want of due energy in the system to institute a restorative course; in the nervous affections, particularly the neuralgic, in which the nervous centres are enfeebled in the general weakness, and unable to resist irritating or otherwise disturbing causes; in the torpor of stomach, liver, and bowels, which are so often met with conjointly in dyspeptic disease; in such cases as these, it is, that we may expect good from travelling. To obtain its full advantages, it is sometimes necessary to persevere long; and a journey of six months, or of one or two years, will often completely accomplish a cure, which, with a shorter continuance of the same means, would be only partial or temporary.

6. COLD AS A TONIC.

Cold is directly sedative; but, as it does not for a time lessen power, while the excitability of the depressed part is increased by its comparative rest, the necessary consequence is that, upon the withdrawal of the cold, and, in some degree, without its withdrawal, the ordinary normal excitants produce more than their ordinary effect, and the part is excited beyond its original condition. Besides, the sensation of cold has, through a wise provision of nature, an excitant influence upon the nervous centres, causing them to send a stimulant impression to the circulatory system, by which injury is obviated. Through the operation of these principles, reaction follows the first depression produced by the cold; and this reaction is not confined to the part first impressed, but extends throughout the system. Thus, cold secondarily elevates the vital functions; and, as this effect is usually moderate, it must take rank among the tonics. The invigorating power of this agent has long been known, as a matter of observation; and it has been much employed in cases of local and general debility. Caution, however, in its use is very important. If too long continued, it at length exhausts excitability, and then produces a steady depression, without reaction. Too intensely applied, it rapidly exhausts the excitability; and the reaction, if produced at all, may be feeble, and soon cease. In proportion to the debility, is this indisposition to reaction; and a degree of cold, which would secondarily stimulate a healthy person, might prostrate still further one already much debilitated. Therefore, in its employment as a tonic, the degree and continuance of the cold should be proportioned to the remaining strength, and the remedy should be abandoned if found to be followed by a feeble reaction, or by none. When the skin is cool, and at the same time relaxed by perspiration, the ability to react is much diminished; and the remedy should never be employed in this state of the surface. When the reaction is insufficient, it should be aided by friction upon the skin, or by muscular exertion.

As a general rule, cold should not be used as a tonic when there is a tendency to dangerous internal congestions, as of the brain or lungs, and should, therefore, be avoided in organic diseases of the heart, which predispose to such congestions. The reason is obvious; namely, that the blood, driven by the cold from the surface, accumulates internally, and thus greatly adds to the pre-existing danger.

Methods of Application. The *cold-air bath* may sometimes be usefully employed. This is applied by simply stripping the body in a cold room, at a temperature from below the freezing point to 60° F., remaining thus exposed for a short time, then dressing, and aiding reaction by moderate exercise.

The *cold-water bath* is more efficient. For the purposes of a tonic, this should seldom have a lower temperature than 60°, and may be as high as 70° or 75° F. When too cold, there is the twofold danger, first that it may not be followed by reaction, and secondly that, if reaction do take place, it may rise too high, even so as to amount to a febrile paroxysm. There can, however, be no fixed point of heat applicable under all circumstances; so different are the susceptibilities of individuals even in health, and so much are these susceptibilities affected by habit, by the degree of debility, and by the varying influence of peculiarity in disease. The general rule is, that the temperature should be sufficiently low to produce a decided feeling of coldness, with shivering, paleness and contraction of the surface, and some reduction of the pulse. The duration of immersion should be no longer than sufficient to produce a decided impression, and should cease at once upon the occurrence of headache, pain in the stomach, cramps in the muscles of the extremities, general uneasiness, a purple colour of the lips, ears, fingers, etc., or other symptom indicating any material disturbance of the vital functions. There is usually a shivering on the first immersion; and a repetition of this should be the signal for leaving the bath. The time may be momentary, it may be for a minute or two, or it may extend, when the temperature is but moderately reduced, to fifteen minutes or more. From 70° to 75°, the bath is scarcely applicable as a tonic, except to cases of ready susceptibility, or considerable weakness, with less than the usual tendency to reaction. In health, the reactive influence, at this temperature, would generally be balanced by the sedative power of the water itself; and little tonic effect would be experienced. A decided, but not excessive reaction is the essential test of the propriety of the remedy; and trial must determine how great a coldness, and how long an immersion are necessary for this result. With a repetition of the remedy, an increase, in one or both of these respects, is generally necessary in order to sustain the original effect. Should but a feeble reaction or none occur, the remedy must be abandoned. Upon leaving the bath, the patient should be wiped quite dry, and then aid reaction by gentle exercise. If he be too feeble for this, the reaction may be promoted by moderate friction. The signs of a sufficient reaction are a general glow, the return of colour to the surface, a fuller and somewhat more frequent pulse, and a feeling of lightness, exhilaration, and increased muscular strength. The head should also be immersed or wetted, in order to prevent determination to that part. The cold bath should not be employed by women in advanced pregnancy, nor during menstruation. It is applicable, as a tonic, only to cases of chronic debility; and especially those of a nervous character, without serious structural lesion. It may be repeated daily, and should be taken rather on an empty than a full stomach. Probably the most suitable period in the twenty-four hours is early in the morning; for then the excitability of the system, having been recruited by rest, is greatest, and reaction will be most apt to take place. The patient, however, should not pass immediately from the warmth of bed into the bath, especially if perspiring. A little exercise previously is desirable, so as to induce a moderate action of the surface, but without perspiration. An hour or two before dinner is also a suitable period, if the excitability of the patient has not been impaired by physical exertion previously; but exposure to the hot sun is an objection to bathing, at this time of day, in the open air.*

The *cold shower bath* is often employed with reference to its secondary tonic effects. It is administered by causing water to fall over the body from a greater or less height, in minute streams, formed by passing the liquid through a vessel perforated at bottom by numerous small holes. A common colander may be employed for the purpose extemporaneously. The shower bath acts on the same principles as the cold bath; but the shock is somewhat greater, and the reaction, therefore, more speedy. It may be employed in similar cases, and with the same cautions. The time of continuance, for a given temperature, should be somewhat shorter.

The *cold douche* is often useful as a local corroborant. It consists in the continuous impinging upon a part of the body of a column of cold water, either falling upon the part, or forcibly impelled against it by mechanical means. It operates upon the same principles locally, as the cold bath does generally; that is, it first depresses, and then secondarily stimulates the part by the reaction. The affections to which it is applicable are old and persistent gouty or rheumatic swellings of the joints, obstinate and indolent tumours, local paralysis, debility of the joints following sprains, nervous deafness, certain conditions of amaurosis, and obstinate weakness of the eyes, sometimes following their acute diseases.

---

* As to effects produced on the system by simple baths, through the absorption of the water, they do not, from the most recent experiments, appear to be such as materially to modify their remedial influence. M. Frédéric Duriau found that, whenever the temperature was below the normal heat of the body, water was absorbed, but never when above it; but the whole amount absorbed was small; not exceeding the average, in three persons, of 561 grains after an immersion of 75 minutes, at the heat of 77° F. (*Archives Générales*, Fev. 1856, p. 165.)

Sea-bathing, or the *cold salt-water bath*, is still more efficacious than the simple cold bath, in consequence of the stimulant influence of the salt on the surface of the body; while, from the same cause, there is less risk of dangerous prostration. The reaction, under its use, is more speedy and certain, and from a less amount of antecedent depression; and patients can remain in it longer without exhaustion. Hence it may be employed in cases of debility, in which reaction, under the use of the simple cold bath, is imperfect or wanting. While adapted to chronic debility in general, it is peculiarly useful in scrofulous affections, as of the bones, joints, and lymphatic glands, both external and internal. Sea-bathing has long been considered as among the most efficacious remedies in these affections. In threatened and incipient phthisis, it may be resorted to with hope of benefit, when the air of the sea-shore is not found injuriously to irritate the lungs. Should it do so, the artificial salt bath should be substituted. But particular caution should be observed, in this disease, to abandon the measure if not attended with full reaction. The probability is that sea-water acts, in scrofula, not only as a tonic, but, through its iodine compounds, as an alterative also; and might be expected, therefore, to be more efficacious than mere salt water.* The salt-water bath may be made by dissolving common salt in water, in the proportion of four avoirdupois ounces to the gallon. When a strong stimulant impression upon the skin is desired, in reference to a revulsive influence from within, the solution may be much stronger; but simply as a tonic, the strength mentioned, which is about that of sea-water, is probably preferable, at least as a general rule.

7. TRANSFUSION OF BLOOD AS A TONIC.

By this process is meant the transfer of the blood of one individual into the blood-vessels of another. It is eminently a tonic measure, as it aims to do directly what some of the most effective tonic medicines, the chalybeates, for example, do indirectly; that is, to increase the quantity, and improve the quality of the blood. The idea of this remedial measure seems to have occurred to the ancients, and, according to Lamartinière, was absolutely carried into effect by them; but, in modern times, no notice of it exists antecedent to the year 1615, when an account was published by Labavius of a case of direct transfusion from a young and vigorous man into another feeble and scarcely breathing, with the effect of restoring the strength of the latter. (*Cyc. of Pract. Med.*, Am. ed., iv. 468.) About the middle of the same century, the measure was tried by Dr. Christopher Wren, of England, upon inferior animals, and soon afterwards (A.D. 1666) by MM. Denys and Emmerez, in France, upon the human subject. Much attention was attracted to it by the experiments of the last-mentioned practitioners, and some favourable results were obtained; but two instances of death, following its employment, brought it into disrepute; and it was forbidden by law to be practised in France until it should receive the approval of the Faculty of Medicine of Paris, which it has never yet received. (*Dict. de Méd.*, xxix. 738.) For considerably more than a century, it remained in total neglect; nor was it till the publication of the experiments of Dr. James Blundell, of London (*Physiolog. and Patholog. Researches*, A.D. 1825), that general attention was again called to it, as a practical measure. By this practitioner, and by others in considerable number who have followed him, it has been satisfactorily established that transfusion, properly performed, is a perfectly safe operation, and may be employed with the happiest results in certain very dangerous cases.

---

* Dr. Beneke infers, from his experiments, that sea-bathing has the effect of increasing the elimination of uric acid, and of the phosphates by the urine. This is what might have been anticipated from its known tonic effects; as these are necessarily attended with an exaltation of the functions generally, and consequently that of nutrition, which implies an increased metamorphosis of tissue, and increased discharge of effete matter by the kidneys. (See *B. and F. Medico-chirurg. Rev.*, Am. ed., Jan. 1856, p. 77.) Sea-water is thought to be more excitant to the surface than a simple solution of common salt of the same strength; and this effect is ascribed by Dr. C. F. Sloan, of Ayr, to the existence in the sea of countless microscopic animalcules, which have the property of irritating the skin. (*Med. Times and Gaz.*, Aug. 1858, p. 176.)

It has been ascertained, as might have been anticipated, that the blood of one animal cannot be safely transfused into the vessels of another, of a different species, in which the normal character of the blood corpuscles is quite different; death, sometimes speedy, sometimes more or less protracted, having resulted from such attempts. But it is not absolutely essential to a favourable result that the animals must be of the same species, provided the blood be of a similar character; for the blood of calves has been transferred to lambs with perfect impunity; and cases have been recorded by Denys and others, in which blood abstracted from men has been replaced by that of lambs and calves, not only without harm, but with beneficial effects. (*Archives Générales*, 4e sér., xxx. 333.) Still, as it is quite certain that the blood of different individuals of the same species may be interchanged with safety, it is undoubtedly the best rule to confine the measure practically within these limits.

The chief dangers of the operation have been supposed to be, first, the entrance of air into the blood-vessels, and, secondly, the coagulation of the fibrin during the transfer. In reference to the former, the case of an insane man operated on by Denys is recorded, in whom, upon the third trial of the process, death suddenly occurred, in consequence, as was supposed, of the entrance of air into the veins; but no other case of a similar kind has occurred; and Dr. Blundell has shown that no danger need be apprehended from this source, with ordinary care. Indeed, from the experiments of Dr. Giovanni Polli, and others, it may be inferred that some bubbles of air thrown in with the blood have no sensible effects whatever. As to the dangers of coagulation, it has been said that small portions of fibrin, solidified in the transferring tube, might be thrown in with the liquid portion, and produce serious consequences by obstruction. But this danger may be avoided by a due degree of activity in the transfer; and, should future experience show that there is really some ground for apprehension from this cause, it may be obviated by defibrinating the blood, previously to injection, in the ordinary method of agitation with sticks. The experiments of Dumas, Prevost, Dieffenbach, Polli, and others appear to show, that blood thus treated has all the revivifying properties of that fluid unchanged, and that the absence of the fibrin is of no account. (*Archives Générales*, 4e sér., xxx. 208.)*

Applications. The main therapeutic application of transfusion has been for the recovery of individuals, greatly exhausted and dangerously prostrated by the loss of blood; and it is particularly in puerperal women, suffering under the effects of uterine hemorrhage, that the remedy has been tried. In these cases, it has proved highly serviceable; having in many instances rescued the patient from impending death, when no other hope apparently remained, and in no one recorded instance been productive of known evil. Of thirty-six cases in which transfusion was performed, in consequence of exhaustion or hemorrhage connected with the puerperal state, collected by Mr. Soden, and published in the *London Medico-chirurgical Transactions* (xxxv. 415), "twenty-nine were recovered from imminent death by the operation;" and of the seven unsuccessful cases, "it does not appear that the fatal termination, in any case, was due to or hastened by the operation." Though used chiefly, as just stated, in puerperal cases, the remedy has proved not less beneficial in exhaustion from spontaneous hemorrhage, and that following wounds and operations, of which Dr. Routh gives examples in a paper published in the *Medical Times* (Aug. 11, 1849); and in one case at least of constitutional hemorrhage, in which the morbid tendency had existed from birth, and the patient had been reduced, by continual bleedings, for five days, to a state of extreme peril, not only were the urgent symptoms relieved, but the predisposition appears to have been eradicated by a consequent change in the character of the blood. (*Arch. Gên.*, 4e sér., xxx. 338.) The remedy has also been found effectual in inanition, dependent on constant vomiting. (*Medico-chirurg. Trans.*, xxxv. 434.) Indeed, this appears to me among its most promising applications. Cases now and then occur in which, without incurable disease of the stomach, this organ becomes so irritable that no food can be retained, and death sometimes results. By allowing the stomach to rest in these cases, and introducing nothing into it except a little cold water, the diseased condition may be corrected by the efforts of nature, if the life of the patient can in the mean time be sustained. This has been done, in some instances, with the effect of saving life, under apparently desperate circumstances, by means of injections of animal broths into the rectum; but, should this measure fail, nothing seems to be more clearly indicated than the occasional transfusion of blood, in such quantities as may be necessary to support the vital functions without undue excitement. In a case of poisoning by carbonic oxide, reported by Dr. A. S. Meldon, the patient was rescued from apparently impending death by the injection of blood. The case occurred in Berlin, and the operation was performed by Prof. Martin. (*N. Y. Med. Journ.*, Nov. 1866, p. 138, from the *Medical Press and Circular*.)

---

* Dr. Brown-Séquard has published some very interesting conclusions in relation to the transfusion of blood, drawn from his own experiments. It has long been known that sudden death, preceded by convulsions, was a not uncommon result of such transfusion made under unfavourable circumstances. This was ascribed to the poisonous effects of the blood of one species when injected into the vessels of another. As defibrinated blood was found to act more favourably than the original liquid unchanged, some thought that the fibrin might be the noxious agent in these cases. It would appear, from Dr. Brown-Séquard's statements, that the real poisonous agent is carbonic acid. Hence venous blood will poison, when the arterial may produce no ill effect. If carbonic acid be expelled from venous blood by impregnating it with oxygen, so as to produce a bright redness, it may then be employed with impunity. The fact that venous blood has not always done harm, is merely ascribable to the small quantity injected at a time; so as to give opportunity for the elimination of carbonic acid by the lungs. A certain proportion in the blood is necessary to fatal effects, as of any other poison. According to this physiologist, blood, whether venous or arterial, from any vertebrated animal, if sufficiently charged with oxygen to become bright-red, may be injected into the vessels of any other vertebrated animal with impunity, provided the quantity be not too great. On the contrary, the same blood, sufficiently charged with carbonic acid to darken it, cannot be injected into veins of a warm-blooded animal, without causing symptoms of asphyxia, and generally death preceded by violent convulsions, unless the quantity injected be less than a five hundredth part of the weight of the animal, and the injection also be very gradually made. These are extremely interesting results; but cannot be acted on with propriety, in the human subject, until amply confirmed by repeated experiment. (*Archives Gén.*, Janv. 1858, p. 107.)—*Note to the second edition.*

Method of Operating. Under the impression that the blood would be injured by exposure to the air, the transfusion was originally effected through a tube, passing from an artery of the supplying individual into an artery of the patient. But this was a very unsatisfactory procedure, and founded, as has been fully established by experiment, upon a false basis. The short period for which the blood is exposed to the air has been found to be attended with no disadvantage. The much more convenient and efficient plan, therefore, has been adopted, of drawing the blood from a vein of the healthy person into a deep vessel, and then immediately injecting it into a vein of the patient, by means of a syringe. The receiving vessel should be placed in warm water, so as to maintain the normal temperature of the blood, and the syringe should be warmed with the same view. The syringe should be plated or tinned within, should work accurately, and should have the capacity of three or four ounces. It is better to operate upon a vein in the arm than in the neck; as there is less risk of the admission of air. The blood should be injected slowly and steadily. Occasionally some force is requisite to overcome the resistance of the vein when collapsed. The quantity of blood thrown in must be regulated by the effects, and the apparent wants of the system. From less than an ounce to more than twenty-four ounces has been employed; about four ounces, in a greater number of cases than any other precise quantity. (*Ibid.*, 421.) In a case operated on by Mr. Soden, the happiest effects followed the introduction of a single ounce. (*Ibid.*, 423.) A new instrument for transfusion, which spares the necessity of using the syringe, has been invented by Dr. Hamilton, of Edinburgh. The reader will find it described in the *American Journal of the Medical Sciences* (Jan. 1863, p. 249).

◆

The tonics may be most conveniently arranged for special consideration in three subdivisions; namely, 1. those of animal, 2. those of vegetable, and 3. those of mineral origin.

I. TONICS OF ANIMAL ORIGIN.

Though an animal diet may be considered as tonic, and this includes many distinct substances, cod-liver oil is the only one, strictly entitled to the name of a medicine, which belongs to this subdivision.

COD-LIVER OIL.

OLEUM MORRHUÆ. U. S., Br.

Origin. Cod-liver oil is obtained from the livers of *Gadus Morrhua*, or the common cod, and several other species of the same genus, inhabiting the waters of the Atlantic, near the shores of Northern Europe and America. It is prepared either by exposing the livers in mass to the heat of the sun, and skimming off the oil as it rises; or by boiling them into a pultaceous mass with water, and straining; or by expression.*

---

* Besides the oil derived from different species of Gadus, which is probably identical, or nearly so, that of the livers of fishes of other genera has been used, for

Sensible Properties. Its consistence is that of ordinary fish-oil. In its purest form, it is of a colour varying from the slightest tint of transparent yellow to a fine golden yellow; when less pure, of a light-brown colour, but still transparent; when most impure, dark-brown and opaque in mass, though transparent in thin layers. Its odour and taste are quite peculiar, scarcely disagreeable in the finer kinds, but offensive in the most impure, which are also somewhat acrid. The oil is injured by long exposure to the air.

Composition. It contains a peculiar principle called *gaduin*, not known to have any medicinal virtue, *various biliary principles*, a *little iodine*, *olein* and *margarin*, and many other constituents of no special interest.

Characteristics. Its most obvious characteristic properties are its odour and taste, quite different from those of ordinary fish-oils, and strongly resembling those of shoe-leather, which owes these properties to the cod-liver oil used in its preparation. Another distinctive property, derived from its biliary constituents, is that of assuming fine changes of colour under the action of the mineral acids. A third peculiarity is that, when heated with potassa or lime, and muriate of ammonia, it yields a smell like that of herring-pickle, owing to the formation of a peculiar volatile alkaloid called *propylamin*. It is frequently adulterated with other oils.

Much has been said in reference to the superiority of one or another variety of cod-liver oil. I believe they are all equally effectual if equally pure, and equally acceptable to the stomach. The darker kinds, which are at the same time very offensive to the smell and taste, often disagree with the stomach, and therefore operate less favourably than the lighter-coloured; but I always regard the possession of the peculiar odour as an essential indication of efficiency; and any specimen of the oil, not possessing it, may be regarded with suspicion.

Effects on the System. When taken in the ordinary doses, cod-liver oil, in the great majority of cases, produces, for some time, no observable effect upon the system. In two or three weeks, however, a fattening process usually commences; and there is a gradual increase of weight, with a moderate exaltation of the functions generally, and an augmentation of the red corpuscles of the blood. In some persons, the medicine produces nausea and disagreeable eructations, and, when the gastric sensibilities are extremely acute, even vomiting; but these results are most frequently dependent rather on its offensive taste, than its direct

---

some of which virtues are claimed very nearly or quite equal to those of cod-liver oil. Among these fish is the dog-fish (*Squalus Catulus*), the product of which M. Devergie believes to be superior to the officinal in sensible properties, while therapeutically it is scarcely inferior. (See *Am. J. of Med. Sci.*, April, 1860, p. 513.) The same is asserted of the *Dugong oil*, obtained from the superficial fat of two species of *Halecore* (*H. Australis* and *H. Dugong*), inhabiting the Australian rivers and bays. (*U. S. Dispensatory*, 12th ed., p. 588.)—*Note to the third edition.*

influence on the stomach; and, if the oil is taken without exciting disgust, are very rare in a healthy state of the organ. Occasionally the functions are over-excited; the medicine proving laxative, diaphoretic, or diuretic, and even augmenting the menstrual flux; and I have very often noticed, after its continued use for two or three months, a decided odour of the oil exhaling from the body, distinctly observable upon a near approach. At length the system seems to be accustomed to its use, and no further change is produced.

In cases of debility and emaciation, with an anemic state of the blood, the alteration is frequently very striking. Beginning two or three weeks from the first use of the medicine, the patient often rapidly fattens, the healthy colour returns, the pulse, instead of being excitable and weak, becomes full, strong, and equable, the appetite and digestion improve, and a healthy vigorous tone of mind takes the place of the previous languor, listlessness, or depression. These effects are all characteristic of a tonic operation, and, as in the case of other tonics, may be carried to excess, so as to produce a plethoric state of system, which is a result to be guarded against in the use of this remedy.

Mode of Operation. It is supposed by some that cod-liver oil acts merely as a nutrient, and differs from other articles of diet only in consequence of its more ready assimilation. But from no other nutritious substance, and no combination of such substances, can equal effects be obtained under the same circumstances. Surely there are many articles of food much more analogous in constitution to our own tissues, and even more readily digested, which, in the ordinary condition of the system, nourish it even better than this oil could do, but utterly fail in the morbid states in which it proves so efficacious. It has been said that it fattens by simply supplying oil in a state in which it can readily enter the blood, and that other oils of easy assimilation will answer the same purpose. But it does not simply fatten. It improves the digestive process, increases the proportion of red corpuscles in the blood, and invigorates the whole nutritive function. The mere increase in the proportion of fat in the system is one of the least important of its results. Besides, other fats do not produce the same effects. Butter, fat pork, the fat of beef, mutton, and veal, olive oil, and various other oleaginous substances are often largely consumed by the very individuals who afterwards find relief, by the employment of cod-liver oil, from morbid conditions which had arisen under the use of these articles of diet. Nothing has been more common, in the hospital of which I have until recently had charge, in the winter season, than to see consumptive patients rapidly improve in their condition under the influence of the oil, though they may have been previously consuming, in abundance, much larger quantities of oily matter in the shape of fat pork. It is true that different practitioners have suggested different oleaginous substances for subliver oil; each maintaining that he has obtained satisfactory results from the one specially recommended. Thus, whale oil, and other kinds of fish-oil, olive oil, almond oil, poppy oil, etc., have been recommended; but, though most of them are much more readily obtainable than pure cod-liver oil, not one of them has held its ground, and secured the confidence of the profession generally, simply because it has failed upon a more enlarged trial. It is proper to state that Dr. Theophilus Thompson, physician of the Brompton hospital for consumptive persons, states, in his published clinical lectures on pulmonary consumption (*Am. ed.*, p. 128), that he has found cocoa-nut oil to possess properties similar to those of cod-liver oil, and to bear comparison with that in its effects; but, if this estimate should prove correct, it would simply prove a close analogy in properties between the two oils, and not that they acted merely as nutrients. From these considerations, I think it must be admitted that cod-liver oil has positive medicinal properties; and the best explanation, I think, of its operation is, that it possesses the power of directly stimulating the blood-making and nutritive functions, in a manner analogous to that of other tonics, and, in certain cases, more effectively than they. Whether its virtues depend upon a peculiar principle, the co-operation of two or more principles, or its general constitution, has not been determined. Some have ascribed its powers to the iodine and bromine it contains; but these are in too small a proportion to exert much influence on the system; are incapable, when given alone, of producing the same effect; and have quite failed when they have been given in combination with other oils, as has sometimes been done in the hope that the artificially ioduretted oil might prove a sufficient substitute for that of the cod.

Therapeutic Applications. Cod-liver oil has recently taken a place among the most valuable articles of the Materia Medica. Used from time immemorial, in the maritime districts of Holland, Germany, and the northern parts of Great Britain, as a popular remedy in rheumatism and rickets, it was first brought to the notice of the medical profession, in the year 1782, by Dr. T. Percival, of England, and was afterwards referred to by Dr. Bardsley, in his *Hospital Reports*, in 1807; but gained little attention until the publication of a paper by Schenck, in 1822, in *Hufeland's Journal*, containing a series of observations upon its efficacy in chronic rheumatism, particularly sciatica and lumbago. After this time, its employment was much extended in Germany, and other parts of the continent of Europe; and numerous communications in the medical journals set forth its claims to high consideration, not only in the complaints above mentioned, but in others, and especially in the different forms of scrofula and tuberculosis. In 1841, it was brought to the notice of the medical profession in Great Britain, as a remedy in phthisis, by Dr. J. Hughes Bennett, of Edinburgh; his reports in its favour were confirmed by the ample experience of Dr. C. B. Williams, of London, and subsequently by that of Dr. Walshe; and, both in that country and in our own, the use of it extended rapidly, until it became almost universal, in the complaint referred to, and in other forms of scrofulous disease.

Cod-liver oil is indicated generally in cases of chronic debility, with impoverished blood, and defective nutrition or assimilation, not connected with inflammation of the stomach. The class of affections in which it has obtained most reputation are those included under the term *scrofulous;* and, in many of these, it has exhibited powers beyond those of all other remedies. To understand its effects, it is necessary to discriminate between these affections.

The name *scrofulosis* may be applied to a condition of system, essentially connected with a low state of the vital forces and defective or depraved nutrition, which exhibits itself under two aspects. In one of these, there is a tendency to the production, in various parts of the body, sometimes in one part, sometimes in another, and sometimes in several parts at once, of a feeble, protracted, obstinate kind of inflammation, strongly tending to the suppurative and ulcerative state, and indisposed to a spontaneous cure, which is usually designated by writers as *scrofulous inflammation*. In the other, there is a disposition to deposit, in the various tissues, a peculiar matter called *tubercle*, which, at first solid, either remains in this condition, irritating the neighbouring parts like foreign matter, or gradually softens, and is ultimately discharged through the inflammation, suppuration, and ulceration of the contiguous structure. These two different local expressions of the constitutional affection may exist quite separately, or may be conjoined in the same case. Now cod-liver oil has an extraordinary influence over the state of system referred to, generally controlling it in a considerable degree, often suspending it for a time when not completely eradicable, and sometimes curing it wholly and permanently.

In the set of cases belonging to the first category above mentioned, those, namely, in which the local affection is simply scrofulous inflammation, the oil will often effect complete cures; because, the morbid condition of system being corrected, and the strength improved, the local lesions are no longer produced, and those already existing are allowed to heal; and life may in general be saved, if the disorganization has not proceeded too far before the application of the remedy.

In the second set, or that characterized by the tuberculous deposit, the diathesis may be in like manner modified or corrected; but the remedy has no influence whatever over the tubercle when already formed, which will exercise its influence upon neighbouring parts, or pursue its own regular course of degeneration, quite independently of any corrective that can be applied. In such cases, it is obvious that the oil can prove curative only when employed, either before the tuberculous deposit has taken place, or when it has occurred in situations, or in quantities, not necessarily destructive of life, through the disorganization of the tissue affected. Thus, when the tubercles are situated in the brain, or the arachnoid membrane, there is scarcely a chance of safety; because, being irremovable, they will ultimately incapacitate, by their irritant influence, this vital organ for the performance of its functions. When, on the contrary, they are deposited in the external lymphatic glands, in the subcutaneous areolar tissue, and even in the bones, there is reasonable hope of a cure; as the parts are less essential to life, and the irritation can generally be supported until the offending matter has been discharged. Again, when such an organ as the lungs is the seat of the deposition, as there is a possibility that the tuberculous matter may be thrown off, it follows that, if the quantity is not so large as fatally to overwhelm the lung by irritation, as in diffused miliary tubercle, or to destroy the organ by ulcerative inflammation in the course of its discharge, or to exhaust the system by the profuse suppuration, and the irritative influence of the local disease, one of which events generally happens in ordinary phthisis, there may be good hope of ultimate recovery. Upon these principles may, I think, be explained the frequent success complete or partial, and the frequent failure also, of the remedy in scrofulous diseases. It will be proper, now, to treat specially of the several affections of this kind in which the oil is used.

External Scrofula. In all the forms of external scrofula, unattended with tuberculous deposition, much good may be expected from cod-liver oil; and, united with other measures calculated to improve the blood, and give vigour to the system at large, a cure may generally be expected. Its effects are peculiarly obvious in the suppurative and ulcerative stage of the affection, whether the lymphatic glands, the subcutaneous tissue, or the skin itself be the special seat of the disease. Scrofulous ulcers and abscesses of the neck, axilla, and groin, or of the skin and the areolar tissue, in any part of the body, often rapidly improve, and ultimately get well under its use. I have seen large and exhausting abscesses of the lower extremities, which have reduced the patient, during months of suppuration, to the lowest condition of emaciation and debility compatible with life, recover slowly but steadily, from the period at which the system was put under the use of the remedy.

Should tubercle, however, have been deposited in the glands, or other part affected, as this must be eliminated before a cure can take place, the result is more tedious and uncertain. In such cases, contrary to what often happens in the non-tuberculous cases, the swellings, whether glandular or otherwise, can very seldom be resolved; and a long process of suppurative ulceration is necessary, before the patient can recover: but even in these cases, much good is often done by preventing the further deposition, by sustaining the strength during the discharging process, and by determining healthy granulation and cicatrization afterwards.

Scrofulous Ophthalmia. Cod-liver oil is among the most efficient remedies in this obstinate affection, conjoined with the local application of nitrate of silver to any existing ulcers of the cornea, or other part of the conjunctival surface. The oil has been recommended also as a local application in these cases; but I have no experience of its use in this way.

Cutaneous Eruptions. When these are associated with scrofulous cachexia, they often yield to cod-liver oil very happily. It is more especially in the *impetiginous* and *ecthymatous affections*, and in *rupia*, that good may be expected; but *eczema* and *pemphigus* are sometimes similarly associated, and similarly benefited; and, in that most obstinate disease denominated *lupus*, this is among the most efficient remedies. In all the cutaneous eruptions, however, it is more the condition of the system that must be considered, in relation to the use of this remedy, than the particular character of the eruption itself. In these, as in ophthalmia, the oil has been recommended locally, as well as by the stomach.

Scrofulous Disease of the Bones and Joints. No other single remedy is probably so efficient as cod-liver oil in this form of scrofula. In *swellings of the hip, knee*, and *other joints*, and in *disease of the bones of the spine, extremities, cranium*, etc., *with or without abscess or caries;* though the cure is often protracted; though more or less of deformity may follow from the organic mischief done; and though death will sometimes take place from exhaustion, when the remedy is applied too late, or even, from the great amount of disease, notwithstanding its employment, yet there are few practitioners, I presume, by whom the oil has been tried, who do not consider it more effective than any other remedy previously used, and who have not found these affections much more manageable by its means than they had been before. As in scrofulous swellings of the glands, there may here also be tuberculous deposition, which adds greatly to the difficulties and dangers of the case; though, happily, it is comparatively rare.

Tabes Mesenterica, or Swelling of the Mesenteric Glands. In cachectic children, there is often much abdominal distension with more or less hardness, sometimes peritoneal effusion and enlarged liver, great emaciation, pallor, and debility, which have generally been ascribed to scrofulous disease of the mesenteric glands. Some of these cases yield quickly and most happily to cod-liver oil, and co-operating treatment; while others are more or less obstinate, and not a few end fatally. This difference of result may be readily accounted for. Some of the cases depend essentially on tubercles, either scattered in the peritoneum or beneath it, or deposited in the mesenteric glands, which they enlarge and harden, or diffused throughout the whole abdomen, causing peritoneal inflammation, which sometimes agglutinates all the viscera together. These are, in general, essentially incurable, except. perhaps, in a few instances, in which the tubercle, originally small in amount, may make its way, through ulceration, into the bowels, or possibly undergo absorption or degeneration. But not unfrequently, also, there are no tubercles; the scrofulous affection of the liver and mesenteric glands being simply of the characteristic inflammatory character; and cases of this kind very often end favourably. The latter cases are most common in infancy, the former in children from two to ten; and, when adults are affected, it is most commonly in the tuberculous form.

Disease of the Bronchial Glands. The same remarks are applicable to these as to the mesenteric glands. In scrofulous cases without tubercle, a cure may be expected; in the tuberculous, the result is more doubtful, though there is reason to believe that the tubercle is sometimes eliminated through the bronchia, and that recoveries take place; but in these cases the danger arises, not so much from the tubercle in the glands, as from that deposited also in the lungs.

Disease in the Stomach and Bowels. Diarrhœa, with ulceration of the bowels, is a not unfrequent attendant on tuberculous affections. Sometimes this depends on tubercles in the substance of the bowels, leaving ulcers as they are discharged; in other instances, it has been found to be unconnected with tubercles. There is reason to believe that scrofulous inflammation sometimes attacks especially the mucous membranes, showing, when it does so, a tendency to affect the follicles, and to result in ulceration of these structures. The gastric mucous membrane may be thus attacked, as well as the intestinal, though it is much more rarely tuberculous than the latter. In these cases, whether tuberculous or not, cod-liver oil is indicated whenever it can be supported by the stomach. Even when tuberculous, there may be hope of a favourable result, if the affection is confined to this part.

Chronic Bronchitis, Laryngitis, Angina, Ozæna, etc. The remarks made in the last paragraph in relation to the mucous membrane of the alimentary canal, are applicable also to that of the respiratory passages, as well as of the pharynx, though tuberculization is uncommon. Hence, in chronic inflammation of the nostrils or ozæna, chronic angina, and chronic laryngitis and bronchitis, when connected with the scrofulous diathesis, cod-liver oil should be tried.

Scrofulous Inflammation of the Serous Tissues. This often exists in connection with tubercles, as already stated in reference to the peritoneum. The pleura, pericardium, and synovial membranes are similarly affected. Whether scrofulous inflammation occupies these tissues without tubercles may perhaps be considered uncertain; but analogy is in favour of the opinion that it does so; and, in relation to the arachnoid, or at least the subarachnoid tissue, and the synovial, analogy is strongly supported by facts. Extensive tuberculization of the proper serous tissues is almost always sooner or later fatal; but the event may probably be postponed by the use of the oil; and, in cases where the inflammation may be supposed to exist without tubercle, the remedy would probably prove occasionally curative. Hence, in chronic cases of these affections, the oil should be employed, not only to correct the diathesis as far as possible in the positively tuberculous cases, but as a curative measure, in the hope that the symptoms may depend simply on inflammation. I have seen cerebral symptoms in infancy, which seemed strongly to threaten chronic hydrocephalus, and were associated with other evidences of scrofulous cachexia, yield happily to this remedy.

Phthisis. The principles upon which cod-liver oil is given in this complaint have been already stated. All that can be hoped for from it is, by improving the constitution, to correct the tendency to the deposition of tubercle, and to support the system during the exhausting process of its discharge. Unfortunately, the diathesis is often so strong, so intimately incorporated as it were with the inherited constitution of the patient, that no known influence is sufficiently powerful to eradicate it; and, though it may be postponed, the fatal result is in most cases inevitable. This much, however, may be said in favour of cod-liver oil, that no one medicine, and no combination of medicines are known, which nearly equal it in efficacy. I believe that, if used before tubercle has been produced, it will not unfrequently prevent it; that, even after a moderate amount has been deposited, it will sometimes arrest its progress, and ultimately save the patient; and that it may, in some few cases, even in the advanced stage of the disease, and after cavities have been formed, rescue from death, if the quantity of tubercle already existing be not sufficient fatally to disorganize the lungs. Of this I have no doubt, that, if begun with early, and used perseveringly, with the aid of other measures calculated to invigorate the general health, it is capable of considerably diminishing the amount of mortality from this fearful disease. All agree that it will often prolong life, when unable to preserve it, and that it very much contributes to the comfort of the patient, especially in the advanced period of the complaint. There is no stage, from the beginning to the close, in which it may not be given with reasonable hope of benefit. The misfortune is, that it is often given insufficiently, being abandoned too early, or taken irregularly, or in too small a quantity; and that patients, in consequence of its unpleasant effects on the palate or the stomach, will not, or, from the irritability of that organ, cannot take it in the requisite amount, or for the requisite length of time. No material effect need be looked for under two or three weeks; and it should not be abandoned, unless after a totally fruitless trial of six weeks or two months. When found useful, it should be persevered with for months or years; and, even after the apparent restoration of health, the least sign of relapse should be the signal for its resumption. In the inherited cases, there is a natural proclivity to the disease, which, though it may be corrected for a time, will again and again evince itself when the restraining cause is removed; and the only chance of safety is in the unremitting use of the proper measures, even when symptoms of disease have disappeared, until, in the spontaneous changes which the system undergoes in the advance of life, the original tendencies may have been subverted.

But it is not in the scrofulous affections only that cod-liver oil is useful. There are other diseases, connected with a cachectic condition of the system, in which it has enjoyed much reputation.

Chronic Rheumatism. This is one of the complaints in which the oil was first used. It has been particularly recommended in chronic lumbago and sciatica, and in obstinate swellings and deformities of the joints. It is no doubt beneficial in some of these cases; but I think it highly probable that not a few of the latter, which were taken for rheumatic, were really scrofulous, and that the remarkable efficacy of the oil may be in part ascribed to that cause. In the Pennsylvania Hospital, I have repeatedly witnessed cases of obstinate and painful swellings of the knee, ankle, or hip, which may possibly have been at first rheumatic, and had been treated as such for months without success, which were attended with great emaciation, a frequent pulse, night-sweats, and other evidences of debility, and were going on in a steady course of deterioration, that threatened death in the end. These cases, under the impression that they were really scrofulous, having either been such in the beginning, or assumed this condition in their progress, I have treated with cod-liver oil, aided by rest, nourishing food, and auxiliary medicines, as iron, quinia, and iodide of potassium, and with the happiest results. At the usual period after the commencement of the remedy, they have begun to exhibit signs of amendment, and have gone on, steadily though gradually, to a perfect cure. How much of the result was ascribable to the oil, and how much to the auxiliary measures, it would be difficult to decide; but my impression on the whole is that, without the oil, I should have been much less successful. The remedy has been recommended in *chronic gout*, but is less efficacious.

Rickets. Perhaps in no disease does the oil display greater powers than in this, occurring in early childhood. Infants, affected with the disease, often begin to improve in a few days under its use, and rapidly advance to complete recovery.

Besides the affections above mentioned, the oil may be used in *chronic anæmia* and *chlorosis*, in *paralysis with debility*, and in various *nervous affections* associated with impoverished blood. It has sometimes proved beneficial in *neuralgia*, probably from this cause. *Amenorrhœa* has sometimes yielded to it; probably through its influence over the blood-making function.

Contraindications. It is contraindicated in an inflamed and irritable stomach, a plethoric state of the circulation, and active local congestion; and when, in the course of its administration, these conditions may occur, either accidentally, or as a result of its operation, its use should be suspended for a time. This caution it is particularly necessary to observe in phthisis, in which, though it is highly important that the blood should be of good quality, yet in quantity it must bear a due relation to the reduced capacity of the lungs; as otherwise it might endanger inflammation or hemorrhage.

Administration. For an adult, a tablespoonful three or four times a day is about the proper dose; and for an infant, a teaspoonful as often; and this quantity should always be aimed at. Some can take the oil out of the spoon without inconvenience; but generally it is desirable to obviate the disagreeable taste by some addition. This may often be done sufficiently by taking an aromatic substance into the mouth, immediately before and immediately after the medicine. Orange-peel has been particularly recommended for this purpose; so also has strong coffee, without cream or sugar, in the quantity of a teaspoonful. The addition of ten per cent. of common salt is said to conceal its taste effectually; but so large a proportion as this might sometimes act injuriously on the stomach or the blood. The oil may also be taken floating in an aromatic water, as that of cinnamon, or one of the mints. But probably the best vehicle, on the whole, is a little frothy porter or ale, which covers the taste very well, and is usually not contraindicated. In hectic cases, the dose of oil may sometimes be advantageously administered in a wineglassful of wild-cherry bark tea. When the stomach is very delicate, it may be given in the form of emulsion, made with an aromatic water; and, when it cannot be otherwise taken, gelatin capsules containing it may be resorted to.*

---

* Various preparations of cod-liver oil, in which it holds other medicines in solution, have been recommended and employed. Such are the *quinated cod-liver oil*, in
which it is impregnated with quinia in the alkaline state; the *ferrugine*
which powdered iron or the recently prepared protoxide are dissolved in
the *iodized oil*, in which it is incorporated with iodine; but none of these
have peculiar virtues; and, when any of the medicines mentioned are
connection with the oil, it is better to administer the two separately; as
liar management which each may require can be thus better regulated. (*N*
second edition.)

Volatile oil of bitter almonds has been found by M. Jeannel, after
periments, entirely to destroy the offensive smell and taste of cod-
quantity required for the purpose is in proportion to the
One grain of the volatile oil will completely disinfect half

It has been recommended to employ the oil externally, by friction, with a view to its constitutional impression; but in this way it would be too offensive for ordinary use, and should be resorted to only when the stomach entirely rejects it. With a view to its local effect, it has been applied to the eye in scrofulous ophthalmia, and to the skin in eruptive complaints.

II. TONICS OF VEGETABLE ORIGIN.

The vegetable tonics may be subdivided into three sets; namely, 1. the pure bitters, 2. the bitters with peculiar properties, and 3. the aromatics.

1. *Pure Bitters*, or *Simple Bitters.*

These are characterized by bitterness with little or no intermixture of other taste, and by a purely tonic power, which is identical or nearly so in all. There appears to be a close relation between the bitter and tonic properties; so much so, that the possession of the former may be considered as *prima facie* evidence of the possession of the latter also. Cullen, indeed, believed this connection to be essential, and taught that it was the tonic power of bodies that gave them bitterness. Bitter substances might have other powers in addition, such as the narcotic and purgative, which might prevent their use in reference to their tonic property, but they still possessed it. He even seems to have thought that the bitterness might reside in a single principle of peculiar composition. This, however, has been shown not to be true. A great number of proximate bitter principles have been discovered, very different in

---

offensive cod-liver oil; but this might injuriously affect the influence of the medicine by adding its own sedative action. Not more than one-quarter or at most one-half of the quantity would be admissible; and the smaller dose would probably be sufficient for any ordinary oil. M. Jeannel, however, thinks that the best agent for the purpose is cherry-laurel water; and it is sufficient to shake the oil with its volume or at most twice its volume of the distilled liquid. The effect is in either case owing to the hydrocyanic acid present; and I have no doubt that the wild-cherry bark tea, referred to in the text, acts in the same way. (*Journ. de Pharm. et de Chim.*, 3e sér., xxxviii. 360.)

In cases in which, though swallowed, the oil is soon afterwards rejected by vomiting, M. Vigla asserts that he has uniformly found this effect to be obviated by administering to the patient, after he has swallowed the medicine, eight or ten grains of calcined magnesia. (*Ibid.*, 3e sér., xli. 248.)

Extract of Cod-liver. A preparation claiming to be an extract of cod-liver, and which, on chemical examination, has been found to contain all the principles of the oil, excepting oily matter and glycerin, has been brought before the notice of the profession as a substitute for the oil. But too little is yet known of it to justify its adoption among officinal remedies (*Chem. News*, Jan. 5, 1866, p. 10.)—*Notes to the third edition.*

composition and chemical relations. Yet I am inclined to think that there is some ground for the opinion of the identity of the two properties. It is easy to conceive that the same arrangement or shape of particles which causes the impression of bitterness on the organs of taste, may give rise to the tonic impression upon the stomach; and that, though all bitters may not seem to be tonic, this may be owing, not to the want of the property, but to the possession of other powers of affecting the system, so influential as completely to overwhelm and conceal it. Nux vomica is tonic in small doses; but, largely given, produces a peculiar effect on the nervous system which quite obscures the tonic. Even quinia, in very large doses, loses apparently all its tonic powers, in its overwhelming influence upon the nervous centres. The same may be the case with other bitters of great medicinal energy, such as colocynthin, elaterin, digitalin, morphia, etc. If reduced in their dose so as to be unable to produce their more powerful and characteristic effect, it is very possible that they might prove tonic to the digestive organs.

Effects on the System. The effects of the simple bitters are to increase the appetite, invigorate digestion, and moderately to exalt the nutritive function. They have little direct influence on the circulation, and perhaps none upon the nervous system. The proper cerebral functions do not appear to be affected by them in any degree, unless in so far as these may be influenced by the condition of the others mentioned. Their main operation is directly upon the mucous surface of the alimentary canal; and their general tonic effects may be ascribed chiefly to the increased quantity, and improved quality of the blood, resulting from the stimulated digestion. It is probable that a stimulant effect is extended sympathetically from the gastro-intestinal surface to the liver and pancreas, upon the same principle as that by which the presence of chyme in the duodenum excites these organs. It is possible that the bitter principles may be absorbed, and, through the circulation, act on the nutritive function everywhere; but this has not been proved in relation to the set of substances now under consideration. One evidence that their direct operation is mainly upon the digestive organs is offered by the fact, that, when they are taken largely, so as to prove irritant, their increased effects are exhibited in those organs, and not directly elsewhere. The simple bitters are apt, in over-doses, to prove laxative, and sometimes nauseate and even vomit; but they do not disturb the heart, nor the cerebro-spinal system, nor any other part of the body, unless in so far as these may feel the condition of the digestive organs.

Therapeutic Application. The simple bitters are especially applicable to cases in which the indication is to promote the digestive function. In pure dyspepsia, they are, upon the whole, the best tonic remedies in our possession. By moderately stimulating the stomach, they probably favour the secretion of a healthy gastric juice, capable of dissolving the food, and thus obviate the stomachic uneasiness, flatulence, and sour or acrid eructations, resulting from the irritation of undigested matters, of substances generated by the chemical reaction of these matters, and probably also of the unhealthy secretions of the weakened stomach itself. They extend a similar stimulant influence to the torpid bowels, and probably also to the torpid liver, thus still further favouring the digestive function. Even in deficient action of the bowels and of the liver, unattended with symptoms of proper dyspepsia, they are often useful, particularly in combination with remedies more especially addressed to those functions. Hence their use as adjuvants to laxatives in constipation, and to cholagogues in jaundice depending on hepatic torpor. From their usefulness in debility of digestion, it follows that good may be expected from them in all those disorders of sensation and function having their root in this affection. Hence, they are among the most efficacious remedies in headache, vertigo, and other deranged cephalic sensations, connected with excess of acid in the stomach; in which cases they should be given combined with an antacid, as magnesia when there is costiveness, chalk when there is diarrhœa, the alkaline carbonates or bicarbonates when there is neither, and aromatic spirit of ammonia when there is great gastric insensibility.

The simple bitters are also well adapted to the debility of convalescence from acute diseases, whether general, as fevers, or local, as cholera, dysentery, and other affections of the alimentary canal. Whenever, under these circumstances, the original disease has been removed, and the appetite remains feeble, and the digestive powers insufficient for the management even of the food that may be taken, the gentle stimulation of the simple bitters is indicated, and will often contribute to the restoration of health.

In all cases of general debility, and of impaired blood, originating in or connected with simple weakness of the digestive function, these medicines may be used with the hope of benefit; and they are often profitably combined with other tonics, which exercise a more powerful direct influence over the system at large.

They were formerly employed in intermittent and remittent fevers; being administered, in the absence or decline of the fever, as antiperiodics, and were supposed to be peculiarly applicable to cases in which the apyrexia was not sufficiently complete for the use of Peruvian bark. But, since the discovery of quinia, this use of the simple bitters has been in great measure abandoned.

They have been supposed to possess anthelmintic properties; and are no doubt occasionally useful in verminose cases. Some have supposed them to operate by poisoning the worms; and experiment has shown that some of them are noxious to inferior animals; but the probability is, that they do good much more by giving proper tone to the bowels, and thus removing the condition favourable to the development of the worms, than by a direct action on the parasites themselves.

They are more frequently given as adjuvants of other medicines than by themselves. They are indicated, in this way, whenever weakness of the digestive function is complicated with the special disease prescribed for. Reference has already been made to their combination with laxatives in constipation, with the mercurial preparations in jaundice, or other cases of torpid liver, and with other tonics in general debility, as with the chalybeates in anæmia. In the various nervous affections, they are often useful in conjunction with the metallic tonics and the nervous stimulants, in dropsy with diuretics, and in amenorrhœa with emmenagogues. The different forms in which they are prepared, as those of powder, extract, infusion, and tincture, afford facilities for these combinations, which should not be overlooked in prescription. When given in chief, they are themselves often aided by the addition of aromatics, as of ginger, orange-peel, etc., which render them more stimulant to the stomach when very languid, and more easily retained by it when irritable.

The different simple bitters are so similar in their effects, that they may be given indiscriminately; one being preferred to another according to convenience, the choice of the patient, or the existence of some idiosyncrasy which may render any one or more of them inadmissible.

I. QUASSIA. *U.S.*, *Br.*

Origin. Quassia is the wood of *Quassia excelsa* (*Simaruba excelsa*, De Cand.; *Picræna excelsa*, Lindley), a lofty tree growing in Jamaica and other West India islands; and of *Quassia amara*, a small tree or shrub inhabiting Surinam. At present, little or none from the latter source is imported.

Properties. Quassia is brought to us in billets, with the bark generally attached; but, as kept in the shops, it is in the form of raspings or shavings, or split into small pieces. The wood is light, porous, yellowish, inodorous, and of an intense, unmixed, and adhesive bitterness.

Active Principle. This is a peculiar, bitter, crystallizable principle, named *quassin.*

Chemical Relations. Quassia yields its virtues to water and alcohol. Its chemical relations are such as not to interfere with the use of any other medicine, with which it may be desirable to associate it in prescription. It is asserted to have the property of opposing, in some degree, though it will not altogether prevent the putrefaction of animal substances.

Therapeutic Application. The use of quassia as a medicine originated in Surinam, in South America. It was introduced into Europe in the year 1756, but was not made generally known until the publication of a dissertation by Linnæus in 1763, after which it came quickly into general use. It was at first supposed to have virtues closely analogous to those of Peruvian bark, and was employed in intermittent and remittent fevers, and sometimes also continued fevers, in the low forms of which its antiseptic properties were thought to render it useful. It was considered as especially applicable to cases in which, in consequence of irritability of stomach, the more powerful febrifuge could not be retained. But this use of quassia has been abandoned. It is now generally admitted to be nothing more than a simple bitter, and to be applicable only to affections in which the tonics belonging to this last subdivision are indicated.

Quassia is asserted to be noxious to insect life. Employed in cabinet-ware, it is said to afford protection against insects, and the infusion has been used as a fly-poison. A grain of the alcoholic extract, inserted into a wound in the leg of a rabbit, is said to have caused the death of the animal on the third day, without any signs of inflammation; and from this, and other observations made of its effects on other animals, and on man, it has been supposed to have narcotic properties; but I have never witnessed any effect of this kind, or anything approaching it; and do not believe that it has the least special influence on the brain. In over-doses, its only known effects are to irritate the stomach and bowels.

The uses of quassia are those of the simple bitters generally, of which it is probably the purest and most powerful. For an account of these, the reader is referred to the general remarks on this set of substances. (See *page* 213.) It is sufficient here to state that the medicine is applicable to all cases of simple weakness of the digestive organs, being much used in dyspepsia, and the debility of convalescence, especially that of febrile diseases and disorders of the alimentary canal, after the entire subsidence of inflammatory action.

In consequence of its noxious influence on worms, it has been employed, in the form of enema, in the treatment of ascarides, and with asserted success. A decoction, made by boiling half an ounce of it in a pint of water, has been used for this purpose.

Administration. Quassia has been little used in the form of powder. Some dyspeptic patients, who have no objection to its bitterness, carry the wood along with them in small pieces, and chew it habitually with advantage. But care must be taken that this habit do not grow into an abuse.

The *Infusion* (INFUSUM QUASSIÆ, *U. S.*) is the preparation in which it is most frequently administered. This is made in the proportion of two drachms to a pint of water. Either cold or hot water may be used, the former making a clearer infusion, the latter acting more rapidly.

The officinal *Extract* (EXTRACTUM QUASSIÆ, *U. S.*) is a very efficient preparation, and is preferable when it is desirable to administer the medicine in the form of pill. It is a watery extract, and probably stronger, in a given a weight, than any other preparation of the simple bitters. It is very convenient for combination with other medicines in the pilular form; such as the chalybeates, aloes and rhubarb, myrrh, mercurial pill or calomel, etc.

The *Tincture* (TINCTURA QUASSIÆ, *U. S.*) is also officinal, and is resorted to, in cases of considerable insensibility of stomach as an addition to the infusion, to other tonic infusions or decoctions, and to liquid purgative preparations.

The dose of the *powder* is twenty or thirty grains, of the *infusion* two fluidounces, of the *extract* from two to five grains, of the *tincture* one or two fluidrachms; each, three or four times a day.

II. SIMARUBA. *U. S.*

Origin. This is the bark of the root of *Quassia Simaruba* (*Simaruba officinalis*, De Cand.), a tree of considerable size, growing in the West Indies, and in Guiana.

Properties. It is in long flat pieces, folded longitudinally, fibrous flexible and tenacious, yellowish internally, inodorous, and very bitter, without admixture of other taste. It yields its taste and medical virtues to water and alcohol.

Active Principle. It owes its virtues to the same bitter principle found in quassia.

Therapeutic Application. Simaruba was first introduced into Europe from South America in the year 1713, as a remedy in dysentery, diarrhœa, and the hemorrhages; and acquired great reputation in these complaints. With our present experience, it can be admitted to have been useful in these affections only when complicated with a debilitated state of the alimentary canal, or of the system, calling for the use of tonics; and, as there are other remedies more efficient under these circumstances, it has fallen into almost entire neglect. It is in fact a simple bitter, having nothing peculiar in its action, and so closely analogous in properties to quassia, that it may be looked on as identical with that medicine in its effects and applications. It is usually administered in the form of infusion, which may be made in the proportion of two drachms of the bark to a pint of water, hot or cold, and given in the dose of two fluidounces three or four times a day.

III. GENTIAN.

GENTIANA. *U. S., Br.*

Origin and Sensible Properties. Gentian is the root of *Gentiana lutea*, and of some other species of Gentiana, herbaceous perennials, growing in the mountainous regions of Europe. It is usually several inches in length, tapering, occasionally branching, sometimes longitudinally sometimes transversely sliced, spongy, wrinkled spirally, grayish-brown externally, yellowish or brownish-yellow internally, of a feeble peculiar odour, and an intensely bitter, slightly sweetish taste.

Chief Constituents. The root contains a peculiar bitter principle called *gentianin*, on which its tonic properties depend; a peculiar organic acid, called *gentisic acid* or *gentisin*, which is without effect on the system; a minute proportion of *volatile oil, uncrystallizable sugar, gum, pectin*, etc.

Chemical Relations. Gentian yields its bitterness and medical virtues to water and alcohol. Containing no tannic or gallic acid, it may be associated in prescription with the salts of iron; but, in consequence of its mucilaginous matter or pectin, it gives precipitates with the acetate and subacetate of lead; and sulphate of zinc occasions a slight flocculent deposit with the hot infusion. Tannic acid causes a bulky precipitate. Sulphuric, citric, and probably other acids sensibly diminish its bitterness. The addition of alkalies does not affect the bitterness; but causes the infusion to gelatinize on standing. (*Procter.*) In consequence of its saccharine matter, the infusion undergoes the vinous fermentation on the addition of yeast, and by distillation yields a spirituous liquor, said to be used as drink in Switzerland.

Effects on the System. Gentian has all the characteristic physiological effects of the simple bitters, being, perhaps, somewhat more excitant to the circulation than most of them. It is said to render the perspiration and urine bitter; and hence its active principle is inferred to undergo absorption. In over-doses it is liable to produce nausea and vomiting, and to act also on the bowels. According to Planche, the distilled water of gentian occasions violent nausea and a kind of intoxication.

Therapeutic Application. Gentian was known by the ancients, and has ranked among standard remedies from a period anterior to the Christian era. It is applicable to all the purposes for which the simple bitters are used, and is among those most employed. (See *page* 213.) As it is thought to be somewhat more excitant than the others, it should be used more cautiously when there is any suspicion of febrile action or gastric inflammation. Its chief employment is as a stomachic in feeble digestion and defective appetite, either original, or connected with, or consequent upon other diseases. As an ingredient in the Portland powder, it was at one time much used in gout; but it is indicated in this complaint only when complicated with dyspeptic symptoms, and even then should be used cautiously, lest it may prove too heating and otherwise excitant. At one time it was thought to be febrifuge; and Dr. Cullen, in his Treatise on Materia Medica, states that, mixed with equal parts of tormentil or galls, and given in sufficient quantity, it had not failed in any intermittents of his own country in which he had tried it; but it would command little confidence at present in the treatment of miasmatic intermittents. Locally, the powder has been used as a gentle stimulant in malignant and sloughing ulcers, and to maintain the discharge from issues; and the root, from its property of swelling with absorbed moisture, has been employed as a tent for enlarging strictured passages.

Administration. Gentian is given in powder, infusion, extract, wine, or tincture.

The officinal *Infusion* (INFUSUM GENTIANÆ COMPOSITUM, *U. S.*) is made with half an ounce of the root, a drachm of bitter orange-peel, and a drachm of coriander, to a pint of menstruum, containing two fluidounces of alcohol and fourteen of water. It is, therefore, a very feeble tincture, and should be used only when, in addition to the effects of a pure bitter, a somewhat more stimulant impression is indicated. The use of the alcohol is to extract the bitterness more thoroughly, and to enable the infusion to keep better. When this is made with water alone, especially with hot water, it spoils readily, in consequence probably of the pectin and mucilage it contains. This disadvantage may be in some degree obviated by the use of cold water, which dissolves less of the principles referred to. The most elegant method of preparing the infusion is undoubtedly by percolation with cold water, by which the bitterness may be sufficiently extracted; and the Pharmacopœia has adopted this plan, using, however, the alcohol with the menstruum. When the infusion is wanted hastily, and is not required to be kept long, it may be most conveniently made with hot water. A combination of senna, gentian, and one of the aromatics, in infusion, is well adapted to cases of dyspepsia with constipation.

The *Watery Extract* (EXTRACTUM GENTIANÆ, *U. S.*) is a good preparation, and is very much used in the form of pill, either alone, or combined with chalybeates, laxatives, etc. Though much weaker than the extract of quassia, it is more convenient for making pills in consequence of its tenacity.

The *Fluid Extract* (EXTRACTUM GENTIANÆ FLUIDUM, *U. S.*) is a preparation peculiar to our Pharmacopœia. It is in fact a concentrated tincture, and may be given in the dose of from ten to forty minims.

The *Compound Tincture* (TINCTURA GENTIANÆ COMPOSITA, *U. S.*) is prepared with the addition of orange-peel and cardamom. It is an excellent tonic and stomachic tincture, and was formerly much used, not only in debilitated conditions of the stomach, but also in health, as an addition to wine before dinner, under the impression that it promoted digestion, and increased the strength. It was called *wine bitters*. In the present state of medical knowledge, it will be generally admitted that this practice could do only harm. Indeed, the bitter tinctures generally require to be used with much caution, even in dyspeptic cases, lest incurable habits of intemperance should be formed. Many a drunkard, in former times, could trace his bad habit back to the use of one of these tinctures, originally perhaps prescribed by his physician.

The *Wine of Gentian* (VINUM GENTIANÆ), formerly directed by the Edinburgh Pharmacopœia, has been very properly abandoned in the British, as there is no occasion for it.

The dose of the *powder* is from a scruple to a drachm; of the *infusion* one or two fluidounces; of the *extract* from ten to thirty grains; of the *tincture* one or two fluidrachms; of the *wine* half a fluidounce to a fluidounce.

◆

Subordinate to gentian, and closely analogous to it in properties, are several medicines derived from plants belonging to the same natural family of Gentianaceæ, which merit a brief notice.

1. **CHIRETTA.** *U. S.*—CHIRATA. *Br.*—Chiretta or chirayta consists of the herb and root of *Agathotes Chirayta* (Don.), an annual plant, growing in Nepaul and other parts of Northern India. It is imported in bundles consisting mainly of the stems, with portions of the root attached. It is inodorous and extremely bitter, and yields its bitterness and medical virtues to water and alcohol. MM. Lassaigne and Boissel have extracted from it a yellow bitter matter, upon which its virtues no doubt depend, but which cannot be considered as a pure proximate principle. The medicine has been long used in Bengal, but has only recently been introduced into Europe and this country. It possesses the properties of the simple bitters, and probably no other; though supposed by some to be more disposed to act on the liver and bowels; being nauseating and laxative in large doses, and asserted to produce bilious stools. In India it has been employed as a febrifuge in intermittent and remittent fevers, as a cholagogue in torpor of the liver, and as a laxative in habitual constipation; but it probably acts, in all these cases, as gentian and the other simple bitters. Like them, too, it may be used in the anorexia of convalescence, feeble digestion, and general debility connected with inertness of the primæ viæ. The dose of the powder is twenty grains; of an infusion made in the proportion of half an ounce of the herb to a pint of hot water, one or two fluidounces; of the tincture (*Tinctura Chiratæ, Br.*), one or two fluidrachms.

2. **AMERICAN CENTAURY.**—SABBATIA. *U. S.*—This is the herb and root of *Sabbatia angularis*, an indigenous, annual or biennial plant, growing in the Middle and Southern States, and collected for use when in flower. The leaves are so small, and shrink so much in drying, that the dried herb seems to consist mainly of the stems, with a few shrivelled flowers at the end. American centaury is inodorous and strongly bitter, and yields all its virtues to water and alcohol. It has long been popularly used, in this country, as a remedy and prophylactic in intermittent and remittent fevers, and has enjoyed, to a considerable degree, the confidence of some practitioners. But it has no special virtues in these affections, in which it acts as a simple bitter, like gentian and quassia, for which it may be substituted in dyspepsia, the debility of convalescence, etc., when on any account more convenient. The dose of the powder is from thirty grains to a drachm. The infusion, which is the most convenient form, and may be made in the proportion of an ounce to a pint of boiling water, is given in the dose of two fluidounces, which, in the remission or intermission of miasmatic fever, should be repeated every two hours, in other cases three or four times a day.

3. **EUROPEAN CENTAURY.**—CENTAURIUM. *Ed.*—This is often called *lesser centaury* (centaurium minus), and consists of the flowering tops of *Erythræa Centaurium* (Persoon), *Chironia Centaurium* (Linn.), a small annual plant, growing wild in some parts of Europe. Its medicinal virtues are said to have been known to the ancients. They are the same as those of gentian, for which it is sometimes employed as a substitute in its native country. In the United States it is scarcely known; its place being supplied by our indigenous centaury, which resembles it so closely as to have received the same name from the earlier settlers. The dose and mode of preparation are the same as those of the preceding article.

4. **AMERICAN COLUMBO.**—FRASERA. *U. S.*—This is the root of *Frasera Walteri* (Michaux), *Frasera Carolinensis* (Walter), an elegant indigenous plant, growing profusely in our Western and South-Western States. Its long, spindle-shaped, fleshy root, being cut into transverse slices and dried, bears a slight resemblance in appearance to columbo, whence, and from a supposed resemblance in medical properties, it derived its common name. Sometimes the root is sliced longitudinally, and thus somewhat resembles gentian, to which it is botanically allied, belonging to the same natural family. It has a yellowish colour, and a bitter, sweetish taste, and yields its virtues to water and alcohol. The bitterness is much less intense than that of gentian; and, though similar in properties, the medicine is not so powerful. The fresh root is said to operate as an emetic and cathartic; but this probably happens only when it is largely administered; and the same is to some extent the case with most of the simple bitters It may be used as a mild tonic,

either in substance or infusion. The dose of the powder is from half a drachm to a drachm; of the infusion, made with an ounce of the bruised root to a pint of boiling water, two fluidounces.

IV. COLUMBO.

CALUMBA. *U. S.*, *Br.*

Origin and Properties. Columbo is the root of *Cocculus palmatus*, a climbing plant, growing in the forests of Mozambique, on the south-eastern coast of Africa. As brought into the market, it is in transverse slices, circular or oval, from one to two inches in diameter, usually three or four lines thick, consisting of a thick exterior cortical portion, with a brownish wrinkled epidermis, and of an interior medullary portion, light, spongy, and more or less shrunk. The cut surface is yellowish, with a greenish tinge near the circumference, of a feeble somewhat aromatic odour, and a very bitter taste, which is strongest in the cortical part. The powder is greenish when fresh.

Active Principles. The root contains two bitter principles on which its virtues depend; one peculiar to it called *columbin*, the other supposed to be identical with *berberina*, an alkaloid found in *Berberis vulgaris*. Besides these, there are a peculiar *volatile oil*, in small proportion, *albumen* and *starch* in large quantity, and other principles of less importance.

Chemical Relations. The bitterness and medical virtues of columbo are extracted by water and alcohol. The infusion, prepared either with hot or cold water, is precipitated by tincture of galls, and the acetate and subacetate of lead; but the bitterness is not affected. No precipitates are produced by the salts of iron, zinc, or copper, nor by tartar emetic or corrosive sublimate. Tincture of iodine does not affect the infusion prepared with cold water, but gives to the decoction or hot infusion, after cooling, a blue colour.

Effects on the System. Columbo has the properties of the simple bitters, with the advantage over several of them, that it is less heating and stimulant, and less apt to irritate the stomach. Buchner states that a grain of the ethereal extract, introduced into a wound in the leg of a rabbit, caused the death of the animal in ten hours; and hence it has been inferred that the root might possess narcotic properties; but this is much too narrow a basis for the support of such an opinion. I have never seen the slightest appearance of narcotism from the use of columbo, though I have prescribed it very frequently and freely. It is probably nothing more than a simple bitter, somewhat qualified by the minute proportion of volatile oil contained in it, which, however, can scarcely have any other effect than possibly to render the medicine more acceptable to the stomach.

Therapeutic Application. This root is said to have been long employed, in bowel affections, by the natives of the country where it is produced. The first published notice of it was by Francis Redi in 1685; but it was not until after the publication of Dr. Thomas Perceval's Medical Essays, in 1773, that it came into general use. It may be employed for all the purposes to which the simple bitters generally are applied (see *page* 213), with this advantage, that, in consequence of its mildness and acceptability to the stomach, it may sometimes be advantageously given when others prove offensive. The affection to which it is best adapted is probably *dyspepsia.* I have found few medicines more efficient in this complaint, when complicated with constipation and flatulence, than a compound infusion prepared with half an ounce of bruised columbo, half an ounce of ginger, a drachm or two of senna, and a pint of boiling water. A wineglassful should be taken before breakfast; if this do not open the bowels, another before dinner; and if this fail, a third in the evening. I have found the combination also promptly successful in *severe gastralgic pains* attendant on an enfeebled stomach. Even when there is reason to suspect the coexistence of some degree of chronic inflammation with dyspepsia, columbo is not always contraindicated; though its use requires more caution. In *gastric irritability,* unconnected with active congestion or inflammation, it is thought by some to have the effect of composing the stomach; and hence it has been recommended in the *vomiting of pregnancy* or *hysteria, bilious vomiting,* etc.; but I have no experience with it in these affections. It has also been especially recommended in the declining stages, or the imperfect convalescence of *remittent fevers,* and of various affections of the primæ viæ, as *cholera morbus, cholera infantum, diarrhœa, dysentery,* etc., under circumstances requiring the use of tonics.

Administration. Columbo is sometimes given in the form of powder, which may be combined with ginger, subcarbonate of iron, or rhubarb, when one or more of these medicines is indicated. The infusion, however, is generally preferable.

The officinal *Infusion* (INFUSUM CALUMBÆ, *U. S.*) is made with half an ounce of the bruised or coarsely powdered root and a pint of water. The present U. S. Pharmacopœia prepares it preferably by percolation; and this may be followed by the apothecary; but the old method of maceration is more convenient extemporaneously. It is a question for consideration whether the water should be cold or hot. The infusion is apt to spoil quickly; depositing a considerable quantity of insoluble matter, becoming more or less ropy, and acquiring a disagreeable taste. This tendency has been ascribed to the use of boiling water, by which the starch is dissolved. But it has been found that the infusion made with cold water is also liable to change, even more so, according to one observer, than the hot, though this does not exactly accord with my own observation. If cold water does not dissolve the starch, it does dissolve the albumen, which boiling water coagulates and renders insoluble; and, as albumen undergoes decomposition very readily itself, and promotes the decomposition also of other associated substances, it may be readily understood why the infusion prepared with cold water will not keep well. To obviate both these difficulties, the infusion may first be prepared with cold water, by which the starch is left behind, and then quickly raised to the boiling point, so as to coagulate the albumen dissolved, which may then be separated by filtration. This nicety, however, is necessary only when the infusion is required to be kept for several days. The most convenient method is to prepare it with hot water, and in small quantities at a time, as wanted for use. When cold water is employed, a much greater length of maceration is required, not less than twelve hours, unless the process of percolation be resorted to. The infusion of columbo may be appropriately combined with the soluble salts of iron, zinc, or copper, or with corrosive sublimate when indicated; but not with the salts of lead. Free iodine should not be given with the hot infusion.

There is an officinal *Tincture of Columbo* (TINCTURA CALUMBÆ, *U. S.*), which may be used like the other bitter tinctures, and is liable to the same objections. (See *Compound Tincture of Gentian*, page 219.)

The *British Pharmacopœia* directs *an extract* (EXTRACTUM CALUMBÆ, *Br.*), which, being prepared with diluted alcohol, is free from the inert starch and albumen, and may be given in the dose of from five to fifteen grains three times a day. The small proportion of volatile oil contained in the root is mainly driven off in the process of evaporation; but the loss of it is probably of little importance.

The dose of *powdered* columbo is from ten to thirty grains; of the *infusion*, two fluidounces; of the *tincture*, from one to four fluidrachms; in each case, to be taken three or four times a day.

* * *

From the simple bitters above described, all the effects which this subdivision of tonics is capable of producing may be obtained; but there are three others, of indigenous growth, which, though less frequently used, deserve a brief notice, as they are scarcely less efficacious, and may sometimes be found convenient.

1. GOLDTHREAD.—COPTIS. *U. S.*

This is the product of *Coptis trifolia*, a very small plant, with a perennial creeping root, inhabiting low and shaded places in the northern parts of this continent, and of Asia. It is abundant in our own Northern

States. All parts of it have some bitterness, which, however, is strongest in the root; and this is the portion directed by the U. S. Pharmacopœia, though, as the medicine is kept in the shops, the roots, leaves, and stems are generally intermingled. The root is long, slender, thread-like, of a deep orange-yellow colour, inodorous, and intensely and purely bitter. It yields its bitterness to water and alcohol. The medicine is closely allied to quassia in its properties, and might probably be substituted for it in all cases without disadvantage; but the smallness of the product of each plant will always be an obstacle to its general use, unless some superiority of virtues can be shown. It is sometimes used, in New England, in aphthous affections of the mouth, as a local application. The dose of the *powder* is from ten to thirty grains; of an *infusion* made with two drachms to a pint of water, one or two fluidounces; of a *tincture*, containing the virtues of an ounce in a pint of diluted alcohol, one or two fluidrachms.

2. YELLOW-ROOT.—ZANTHORRHIZA. *U. S.*

By this name is designated, in the secondary list of the U. S. Pharmacopœia, the root of *Xanthorrhiza apiifolia*, an indigenous shrub, growing in the interior of the Southern, and in the Western States. Though the bark of the stem, as well as the root, is bitter, the latter only is officinal. This is cylindrical, from three inches to a foot long, about half an inch thick, yellow, inodorous, and extremely bitter, without astringency. It imparts its colour, bitterness, and medical virtues to water; and the infusion is not affected by the salts of iron. It may be employed in the same affections, in the same manner, and in the same dose as quassia.

3. STAR-GRASS.—ALETRIS. *U. S.*

This is the root of *Aletris farinosa*, a small indigenous herbaceous perennial, named from the star-like form assumed by the leaves, which spread out on the ground at the base of the stem. The root is small, branching, crooked, blackish outside, brownish within, and strongly bitter. It imparts its bitterness to water and alcohol, but, it is asserted, much more freely to the latter. Little is known of its composition. In small doses it acts as a simple tonic, and may be given for the same purposes as the simple bitters. But in large doses, like most of the articles of this class, it is apt to disturb the stomach and bowels, and is said, when taken in great excess, to have acted as a narcotic. The powder may be given in the dose of ten grains for the tonic effect.

2. *Peculiar Bitters.*

These are medicines which, with the simple tonic powers characteristic of the pure bitters, possess others also, which modify the tonic action, and give them an influence on the system more or less peculiar.

This peculiarity may be owing either to the distinctive character of the bitter principle itself, or to some other principle or principles which may be associated with it. Thus, Peruvian bark owes its characteristic remedial virtues to the peculiarity of its bitter principles; while serpentaria and wild-cherry bark have other active constituents besides the bitter; the additional constituent being, in the one, hydrocyanic acid which is sedative, and in the other, a stimulating volatile oil.

I. PERUVIAN BARK.

CINCHONA.

Origin. This is the bark of different species of *Cinchona*, trees growing in South America, along the course of the Andes, extending from the northern coast near Caracas to La Paz in Bolivia, through nine degrees of latitude, at various elevations on the mountain sides, seldom less than four thousand feet above the level of the sea. The species known to yield bark to commerce are *C. Calisaya* and *C. Boliviana*, growing in Bolivia; *C. micrantha*, *C. nitida*, and *C. ovata*, inhabiting the provinces of Huamilies, Huanuco, etc., in the interior of Peru; *C. Condaminea*, *C. scrobiculata*, and *C. succiruba*, of northern Peru and Ecuador; and *C. lancifolia*, *C. cordifolia*, and *C. Pitayensis*, of New Granada; beside several others less known, or of less importance.

Classification. The varieties of Peruvian bark may be arranged in two divisions; 1. the *officinal* or those recognized in the U. S. Pharmacopœia, and brought exclusively from the Pacific coast of S. America; and 2. the *non-officinal*, commonly designated as *Carthagena barks*, and exported from the northern coast of the continent. The officinal barks are divided by the Pharmacopœia into the *pale*, *yellow*, and *red;* the non-officinal include the three varieties of *hard Carthagena*, *fibrous Carthagena*, and *hard Pitaya* bark.

Properties. Peruvian bark is in quills or flat pieces, of various dimensions, with or without epidermis, of a yellowish-brown, reddish-brown, reddish, or orange-brown colour in the interior, of a feeble somewhat aromatic odour in powder or decoction, and of a bitter taste varying in degree, sometimes nearly pure, but more commonly also nauseous or astringent. It yields its virtues partially to pure water, but completely to alcohol, or to water acidulated with sulphuric or muriatic acid. The several varieties require special notice.

1. *Classification of Peruvian Barks.*

a. *Officinal Barks.*

1. **PALE BARK** (CINCHONA PALLIDA, *U. S.*, *Br.*) is in cylindrical pieces, called quills from being rolled, from a few inches to eighteen in length, from two lines to an inch in diameter, and from half a line to two or three lines thick. The colour of the epidermis, which is always adherent, is light-gray, brownish-gray, or grayish-fawn; of the true bark, brownish, more or less deep, and inclining to red, yellow, or orange; of the powder, pale-fawn, and sometimes dusky. The taste is moderately bitter, somewhat astringent, and not nauseous.

The commercial varieties belonging to this division are 1. *Loxa barks*, usually in smallish quills, derived from C. Condaminea and other species, and named from the town of Loxa, which was formerly the entrepot of the trade in them; 2. *Lima* or *Huanuco barks*, usually larger than the preceding, derived from C. micrantha, and C. nitida, and named from the town of Huanuco in the neighbourhood of which they are gathered, or from Lima, where the trade in them centres; 3. *Jaen* or *ash-bark*, differing little in size from the Loxa Barks, named from the town of Jaen, supposed to be derived from C. ovata, and scarcely known as a distinct variety in the commerce of the United States; and 4. *Huamilies bark*, of larger size, in flat pieces and quills, named from the province where it is gathered, conjecturally referred to C. pubescens, and little if at all known in our markets.

2. **YELLOW BARK** (CINCHONA FLAVA, *U. S.*, *Br.*), called in commerce *Calisaya Bark*, is in quills and flat pieces; the former from three inches to two feet in length, from a quarter of an inch to two inches in diameter; the latter, quite flat or slightly curved, usually thicker than the quilled, and derived from the larger stems or branches. The epidermis is in general easily separable, and is often separated from the proper bark, especially in the flat pieces, which are almost always quite free from it, and, on their outer surface, show that it was removed without violence, from the mere looseness of adhesion. When present, it is of a brownish colour diversified with whitish lichens, is marked with longitudinal wrinkles and transverse fissures, and is tasteless and inert. Without it, the bark is from one to two lines thick, firm and compact, of a short fibrous fracture with shining points, and, when viewed along its length, exhibiting similar shining points, which are the ends of small transparent spicula. These spicula, when the bark is rubbed, separate from it, and prove highly irritant to the fingers, like cowhage. The colour of the bark is a fine brownish-yellow, usually with a tinge of red; the taste, intensely bitter without astringency or nauseousness; the powder, of a bright yellowish-cinnamon hue, often inclining to orange. The officinal

yellow or Calisaya bark is the product mainly of Cinchona Calisaya, and is obtained exclusively from Bolivia.

3. **RED BARK** (CINCHONA RUBRA, *U. S.*, *Br.*) is, like the preceding, in quills or flat pieces; the former, completely or partially rolled, of various lengths, sometimes exceeding eighteen inches, and from less than half an inch to more than two inches in diameter; the latter, often very large and thick. The epidermis is strongly adherent, of a reddish-brown, gray, or whitish colour, wrinkled longitudinally, and sometimes warty. Beneath the epidermis is a layer, dark-red, compact, brittle, and of feeble taste. The proper bark is woody and fibrous, of a brownish-red colour, passing from deep-red to reddish-yellow, and of a taste very bitter and somewhat astringent. The colour of the powder is a fine brownish-red. The origin of this bark was till recently unknown; at present, however, through the researches of Mr. Howard, of London, it is referred very confidently to *C. succiruba* of Pavon (*C. ovata*, var. *erythroderma* of Weddell), growing in the republic of Ecuador, on the western slope of Chimborazo.

b. *Non-officinal or Carthagena Barks.*

1. **HARD CARTHAGENA BARK** comes usually in pieces somewhat regular in shape, either completely or partially quilled, or flat, and frequently warped; the quills being from five inches to a foot long, from three to eight lines in diameter, and from half a line to a line and a half thick; the flat, somewhat thicker, about the same in length, and from one to two inches broad. But sometimes also it comes in small irregularly square or oblong, flattish pieces, variously warped, and mixed with small quills or fragments of quills. The epidermis is often absent, especially from the larger and flatter pieces, having been obviously scraped or pared off with a knife, and not separated, as in the Calisaya bark, by the natural juncture. When present, it is usually soft, whitish or yellowish, and of the character which has been called micaceous. The proper bark is of a pale, dull, brownish-yellow colour, often appearing as if rubbed over with the powder. Its texture is firm and compact; its fracture abrupt, though not smooth; its taste bitter and nauseous. It is derived from Cinchona cordifolia.

2. **FIBROUS CARTHAGENA BARK** is in quills, half quills, slightly rolled, or flat pieces, of dimensions and shape not materially different from the preceding, and like that coming generally in somewhat regular forms, but sometimes in small irregular fragments. Some of the largest pieces exceed in thickness and other dimensions any that I have seen of the hard variety. The epidermis when remaining is soft, whitish or yellowish, and micaceous; but in the larger and flatter pieces it is generally absent, being artificially removed, as in the preceding. The proper bark differs much in character from the hard variety, being very fibrous,

light, loose, soft, and spongy under the teeth. Its colour varies from a light brownish-yellow to an orange or red, the latter existing especially in the largest pieces. The colour of the powder is yellowish, often with an orange tint. The taste is usually bitter, but varies much in degree, being in some specimens strong, in others very feeble. The fibrous Carthagena bark bears considerable resemblance in colour to the Calisaya, but differs greatly in its soft and spongy consistence, and in the circumstance that its epidermis has been artificially removed by the knife, instead of spontaneously separating at the natural junction. It is the product of Cinchona lancifolia.

3. **HARD PITAYA BARK,** or *Brown Carthagena bark*, as it has sometimes been called to distinguish it from the two preceding, which are sometimes designated as *yellow Carthagena bark*, is usually, as I have seen it, in small irregular pieces, either quilled or flat, from one to four inches long, and from one to four lines thick. The epidermis is sometimes whitish and soft as in the other Carthagena barks, but sometimes also dark-brown, with innumerable cracks in different directions, giving the surface a grater-like appearance. Sometimes it is absent. Beneath the epidermis there is often a resinous layer, of a dark reddish-brown colour, and a shining surface when cut; but, though highly characteristic when present, it is wanting in some of the pieces. The proper bark is rather hard, compact, and heavy, closely and finely fibrous, and of a dull yellowish-brown colour with a reddish tint. It somewhat resembles the hard Cathagena, but differs in the resinous layer, the grater-like epidermis of many of the pieces, and the deeper and redder colour. It has a very bitter taste. It is probably the product of the Cinchona Pitayensis of Weddell.

2. *Constituents and Chemical Relations.*

*Constituents.** The most important of these are the alkaloids, *quinia*, *cinchonia*, *quinidia*, *cinchonidia*, *quinicia* and *cinchonicia*. Of these there are two distinct groups, one consisting of quinia, quinidia, and quinicia, all isomeric, and cinchonia, cinchonidia, and cinchonicia, which are also isomeric, but differ in composition from the first group. The last of each group, quinicia, namely, and cinchonicia, appear to result from the influence of heat upon the respective alkaloids with which they are isomeric, and, though they may possibly sometimes pre-exist in the bark, are more frequently the result of the chemical processes employed in the extraction of the others. The alkaloids are believed to exist in the bark chiefly in combination with *kinic acid*, in the form of soluble kinates, but partly also combined with colouring matter or tannic acid, forming compounds insoluble in water, which, therefore, is of itself incompetent to exhaust all the virtues of bark. Other constituents are a bitter substance called *kinovic bitter* or *kinovic acid*, *tannic acid*, a *red colouring matter* called *cinchonic red*, a *yellow colouring matter*, *resin*, *gum*, *starch*, *fatty matter*, *kinate of lime*, etc.

---

* Since the publication of the first edition of this work, the subject of the cinchona alkaloids has been carefully investigated; and a general view of the results, somewhat different from the account of these alkaloids given in the former edition, is now presented in the text. (*Note to the second edition.*)

Properties of the Alkaloids. The alkaloids are the active principles, and exist probably in all the varieties of bark, though in very different proportion. In the pale barks, cinchonia predominates; in the officinal yellow or Calisaya bark, quinia is most abundant; in the red, both these alkaloids are found in considerable proportion; while in the more active of the Carthagena barks, quinidia exists largely.

Quinia, which may be obtained by decomposing the sulphate by means of an alkali, is whitish, flocculent, crystallizable with difficulty, inodorous, and very bitter. It is fusible by heat without chemical change, is very slightly soluble in cold water, somewhat more so in boiling water, and very soluble in alcohol, ether, and the volatile and fixed oils. With the acids it forms crystallizable salts, of which there are two sets, one containing twice as much acid as the other. Different views are entertained of the equivalent constitution of these salts; some believing those containing the smaller proportion of acid to be sub-salts (with one eq. of acid and two eqs. of base), and those containing the larger proportion to be neutral (with one eq. of acid and one of base); while others consider the first set to be neutral (with one eq. of acid and one eq. of base), and the second to be super or bi-salts (with two eqs. of acid and one eq. of base). Thus, the two sulphates would be denominated by one party disulphate and sulphate of quinia, by the other sulphate and bisulphate. Of course, the equivalent of the alkaloid is stated differently, according to these different views; being 162 in accordance with the former, and double that number with the latter. Quinia is distinguished from all other substances, with the exception of its isomeric alkaloids, by the emerald-green colour which its solution, or that of its salts assumes, when treated, first with chlorine, and then with ammonia, and which changes to violet upon saturation with a dilute acid.

Quinidia, though isomeric with quinia, differs from that alkaloid in crystallizing readily, in being less soluble in ether, and in its influence on polarized light. It differs also from this, and all the other cinchona alkaloids, in the circumstance, that a solution of its sulphate yields a white precipitate with solution of iodide of potassium. Its crystals effloresce on exposure to the air. It resembles quinia in its chemical relations with chlorine and ammonia.

Quinicia differs from quinia in being apparently quite uncrystallizable, and in its effects on polarized light; but agrees with it in composition, and in most of its chemical relations. It is, indeed, in all probability, the result of certain molecular changes produced in quinia by the influence of heat used in its extraction. It is not employed separately in a pure state.

Cinchonia may be prepared from the sulphate in the same manner as quinia from its sulphate. It is white, crystallizable, almost insoluble in cold water, very slightly soluble in boiling water, freely soluble in boiling alcohol, which deposits it on cooling, scarcely soluble in ether, and but slightly so in volatile or fixed oils. In consequence of its comparative insolubility, it is much less bitter than quinia; scarcely having any taste when first applied to the tongue, but becoming bitter in a short time as it dissolves; and its solutions are very bitter. By a moderate heat it melts, but is at the same time decomposed. It forms with the acids crystallizable salts, of which, as in the case of quinia, there are two sets, to which the same remarks are applicable as those made in reference to the salts of the latter alkaloid. Its equivalent is consequently given differently, either 154, or double that number. It is distinguished by affording a white precipitate, when its solution, or that of its salts, in chlorine water is treated with ammonia.

Cinchonidia bears the same relation to cinchonia that quinidia does to quinia. Like cinchonia it forms anhydrous crystals, which do not like those of quinidia effloresce in a warm air. It also agrees with its isomeric alkaloid in not producing a green colour with chlorine and ammonia; but is more soluble in ether than cinchonia, and differs in its influence on polarized light.

Cinchonicia, which is derived from cinchonia, is isomeric with it, and resembles it in chemical relations, but differs in being amorphous or uncrystallizable. Neither this, nor the preceding alkaloid is prepared separately for use, in a pure state, at least in any considerable quantity.

Under the name of *quinidia* or *quinidine*, an alkaloid substance was some time since brought into notice, and to some extent introduced into commerce, which Pasteur found to consist usually of the two alkaloids, named respectively quinidia and cinchonidia, but chiefly and sometimes exclusively of the latter. This has led to an unfortunate confusion of nomenclature; but the student should remember that what was commonly called quinidia in commerce, and still to a certain extent retains that name, is really in great measure cinchonidia. The nomenclature adopted here, after Pasteur, is necessary as expressive of the true relations of the several alkaloids.

The substance sometimes called *quinoidine*, which in its pure state is the *amorphous quinia* of Liebig, and is obtained from the mother waters left after the precipitation of sulphate of quinia, in the process for preparing that salt, is usually a mixture of quinicia and cinchonicia, and results from the reactions which take place in the process; the crystallizable alkaloids having been rendered, by molecular change, amorphous or uncrystallizable.

Chemical Relations and Incompatibilities. The alkalies and their carbonates, and the alkaline earths, precipitate the alkaloids from the infusion and decoction of bark; tannic acid, and all the astringent substances containing it, precipitate insoluble tannates of the alkaloids. By the reagents mentioned, therefore, the liquid aqueous preparations of bark are deprived of the active principles of that medicine; but, as the precipitated matter is active, the preparations, if the sediment be diffused through them, will still be efficient, though inelegant from their turbidness. The same may be said of the slight precipitates produced by the soluble salts of oxalic, tartaric, gallic, and acetic acids, in consequence of the difficult solubility of the compounds of these acids with the cinchona alkaloids. These precipitates, moreover, are redissolved by a slight excess of acid. Besides the precipitants mentioned, all of which disturb the relations of the active principles, there are many others, which, through reaction with the tannic acid often found in bark, or with other relatively inert constituents, form insoluble compounds, and occasion turbidness or deposition in the infusion. Among these are the soluble salts of lead, iron, zinc, silver, and mercury, tartar emetic, arsenious acid, and solutions of gelatin. Some of these act on certain varieties of bark, and not on others; as, for example, tartar emetic, which sometimes produces copious precipitates, and sometimes does not disturb the infusion. In consequence of the large proportion of kinate of lime in the Calisaya or officinal yellow bark, a strong infusion of this variety is precipitated by sulphate of soda, which does not affect most of the other barks. But the virtues of the infusion are not impaired by these reagents, as the active principles remain undisturbed; so that the incompatibility has reference, not to the Peruvian bark, but to the substance added.

Signs of Value. The taste affords some evidence of the strength of bark, which, as a general rule, may be considered proportionate to the bitterness; but this test cannot be relied on with certainty; as in some inferior barks there is considerable bitterness, in consequence of the presence of kinovic acid, which has not the characteristic virtues of the medicine. The best method of testing any specimen of bark is to determine the percentage of the alkaloids contained in it, which is a pretty accurate measure of its medicinal activity. For the method of doing this, the reader is referred to the U. S. Dispensatory (*12th ed., p.* 295).

3. *Effects of Peruvian Bark on the System.*

As the virtues of the bark reside mainly in its alkaloids, and these are closely analogous in their effects, it will be most convenient to treat first of quinia, as the one best known and most used; and afterwards to point out any difference that may exist between its operation and that of the bark itself, or the other alkaloids. The effects of quinia are usually obtained from the sulphate; and this may be considered, in the following observations, as representing the alkaloid.

When sulphate of quinia is administered to a healthy person, in quantities not exceeding six grains daily, in doses of half a grain or a grain, it produces effects very analogous, if not identical with those of the simple bitters. At first no sensible effects whatever may be experienced; but, after a short time, the appetite is increased, the food appears to be more rapidly digested, the pulse becomes somewhat fuller and stronger, if not accelerated, the temperature of the surface is correspondingly elevated, the processes of sanguification and nutrition are promoted, and other vital functions are moderately stimulated either directly or indirectly. In other words, the medicine operates as a pure tonic, according to the definition of the term given in this work. In irritable states of the digestive organs, or of the system at large, these effects are sometimes exalted, by the free use of the medicine, into a moderately febrile state, with anorexia, gastric oppression, thirst, a furred tongue, accelerated pulse, heat and dryness of the surface, and headache or other cephalic uneasiness. This condition, however, is probably not the direct result of the action of the medicine upon the system at large, but indirect, and symptomatic of some local irritation produced by it, especially in the stomach or other parts of the digestive apparatus. This state of excessive excitement is rarely experienced in health; because, with an increase in the quantity of quinia administered, other effects are developed, of a contrary tendency, which overcome its general excitant influence.

Given to the amount of from six to twelve grains daily, in divided doses, or to a less amount in a single dose, sulphate of quinia evinces a tendency to act specially upon the brain, and often produces very decided effects upon that organ. The quantity, however, necessary to the production of obvious cerebral symptoms, varies greatly in different individuals; some evincing an extraordinary susceptibility to the influence of even small doses, while others scarcely feel the largest quantity above mentioned. The first cerebral phenomenon usually presented is abnormal sound, such as buzzing, roaring like that of a strong wind or of a cataract, singing, hissing, ringing, etc. Along with this there is generally more or less hardness of hearing, which, indeed, is one of the most characteristic effects of quinia. Uneasy sensations in the head are also frequent, as of weight, fulness, tension, and sometimes positive pain, though very seldom severe. The circulation is not much affected; the pulse being sometimes increased sometimes diminished in frequency, but for the most part little altered.

When, instead of the quantities above mentioned, from twelve to sixty grains or more are given daily, in divided doses, the effect upon the cerebral functions is increased, and a decided sedative influence upon the circulation produced, as evinced by a diminution of the frequency and force of the pulse, proportionate to the amount of the salt used. Along with the abnormal sounds before referred to, there is now giddiness or dizziness; the individual, if erect, often staggers; occasionally there is irregular muscular movement; the hardness of hearing is not unfrequently increased to positive deafness, and in a few instances vision is disturbed and blindness induced. At first, if the individual dose is large, there may be flushing of the face, headache, and sometimes epistaxis, indicating decided sanguineous determination to the head; and occasionally, though very rarely, active delirium occurs. In experiments upon dogs, even meningitis has in some relatively few instances been brought on by very large doses. (Briquet, *Traité Thérap. du Quinquina*, p. 161.) But these evidences of over-excitement of the brain give way to others indicating a reduction of nervous power, such as diminished hearing and sight, uncontrollable tremblings, depressed spirits, sighing or yawning, and very rarely a kind of mental disorder, compared by Dr. James McCaw of Virginia to delirium tremens. (*Stethoscope*, ii. 666.) In some instances, a tendency to drowsiness or stupor is evinced; in others, morbid wakefulness; but in the greater number, neither the one nor the other. Though the pulse is at first sometimes temporarily excited by these large doses, probably in sympathy with the excited brain, it in general soon becomes slower, and always feebler. The pulsations of the heart are often reduced ten or twelve in the minute, sometimes as much as twenty or twenty-five; and the whole number in the minute to forty, but seldom if ever lower. In strength, the pulse is diminished very nearly in proportion to the dose, as shown by the experiments of Briquet upon dogs, by means of Poiseuille's hæmadynameter; and, in extreme cases, it may be so much reduced as no longer to be felt at the wrist. The skin at the same time becomes cool, pale, and moist, and the face pale or livid, and shrunk.

This prostration under the use of quinia may be carried so far as to constitute real poisoning. Death has often been produced in dogs by excessive doses; and in one case, cited by M. Guersent, the same result is said to have taken place in the human subject.* Giacommini, who first called attention to the powerful sedative influence of quinia, records the case of an individual, who took by accident about three drachms of the sulphate. Extreme prostration came on, with an almost absent pulse, cold skin, slow respiration, feeble voice, and apparently imminent danger of death, which was, however, averted. In these prostrate cases, the pupil is often dilated, and there is sometimes coma.

---

* In this case, M. Bazire, a practitioner of medicine, in an excited state of imagination bordering on insanity, believing himself to be attacked with pernicious fever,

Hitherto our attention has been directed to the influence of quinia, in large doses, upon the circulation, or the cerebral functions.

But it also produces other effects. It has been supposed by some to render the blood more fluid, and to lessen its coagulability by diminishing the proportion of fibrin, or altering its quality; and in some cases, in which death has occurred during its administration, the blood has been found fluid. But this result was ascribable to the existing disease, and not to quinia; and more numerous experiments and observations have proved that, in any quantity in which it can be introduced into the system, it does not impair the coagulability of the blood. Indeed, Briquet found, in his experiments, that it had the opposite effect of increasing the proportion of fibrin.

It has been said that quinia has the property of immediately reducing the bulk of the spleen. This view of it was taken by Piorry, but has not been fully sustained by other observers; and the existence of the property must be considered as doubtful. Enlargement of the spleen is undoubtedly often gradually diminished under the use of quinia, especially in miasmatic fevers; but it is quite as probable that the effect proceeds indirectly from the removal of the cause, as directly from the operation of the remedy on the organ.

In the urinary passages quinia occasionally induces irritation, proba-

---

took within a short time 60 grammes (very nearly two ounces Troy) of sulphate of quinia by the mouth and rectum. Symptoms of great prostration, with loss of sight and hearing, came on, which he unfortunately ascribed to the pernicious fever, and hoped to counteract by a continuance of these enormous doses. In the course of nine or ten days, he took additionally five ounces of the salt. Another physician being then called in, found him covered with cold sweat, completely deaf and blind, with difficult and rattling respiration, profound stupor, and an expression of countenance like that of drunkenness. Though partially roused with much difficulty, so as to give rational answers, he quickly became delirious, and died. (*Dict. de Méd.*, 2e ed., xxvi. 570.)

A case is recorded in the *London Med. Times and Gaz.* (April, 1864, p. 461), in which *one ounce* of sulphate of quinia was given, by mistake, to a soldier affected with ague, with no other unpleasant effect than a kind of stupor and complete deafness, which left him after a time; and at the end of a week he was quite well, having lost his ague. No antidote was used. From these two cases it may be inferred that, though quinia may sometimes be taken with impunity, by a strong man, in the quantity of an ounce; yet double the quantity may prove fatal; and a legitimate caution would limit the dose far within the smaller amount mentioned. (*Note to the third edition.*)

bly by its direct contact with the mucous membrane of these passages, as it escapes with the urine. Dr. E. Hardy has shown that quinia begins to pass out with the urine in less than seven minutes from its exhibition by the mouth. (*Journ. de Pharm. et de Chim.*, 3e sér., xliv. 160.)*

The alkaloid is not generally thought to exercise any special influence on the genital function; though it may no doubt operate beneficially, in certain abnormal states of that function, through its tonic powers. It is, however, believed by Dr. Cochran, on the basis of numerous experiments, that it has the property of exciting the menstrual function by a special influence; accelerating and augmenting the menses when it is given a short time before the regular period, and restoring them when arrested by cold or other cause. (*Ann. de Thérap.*, A.D. 1860, p. 194.)

Occasional effects are experienced from quinia differing from those which are most common and characteristic. Sometimes it irritates the stomach considerably, causing a sense of weight or oppression, gastric pains, and nausea or vomiting. This is especially the case in febrile diseases, in which the stomach is already not unfrequently in a state of irritation, or strongly disposed to it. Sometimes also it acts similarly on the bowels, causing griping pain, and diarrhœa. It has been accused of producing constipation; but this is doubtful. Its operation, in large doses, is sometimes attended with great oppression of chest and precordial uneasiness, probably dependent upon its irritant influence over the nervous centres. Mr. W. H. Vipan states that, in several cases which have come under his notice, purpura has appeared immediately after the use of quinia. (*Lancet*, July 8, 1865, p. 37.)

The constitutional effects of quinia are essentially the same, by whatever avenue it enters the system, whether taken by the stomach, injected into the rectum, or introduced into the areolar tissue, the serous cavities, or directly into the circulation. When applied to the skin denuded of the cuticle, it produces so much irritation as materially to interfere with its absorption.

The period, after its administration, at which quinia begins to evince signs of its characteristic action on the nervous system, and the length of time during which these signs persist, vary with the dose and the intervals of exhibition. Less than three or four grains, in one dose, rarely produces any sensible effect; six or eight grains usually occasion some cerebral disturbance in half an hour, an hour, or at the latest two hours; while from twelve to sixteen grains, or more, may operate sensibly in so short a time as fifteen minutes. But, when the medicine is given in the dose of a grain or two, repeated at intervals of one or two hours, little or no effect on the nervous system is experienced until nine or ten grains have been taken; and often considerably more is required. The operation of a single dose, just large enough to make itself felt, say five or six grains, continues generally two or three hours; of double the quantity, given through the day, in divided doses, about eight or ten hours; of larger amounts, given in the same way, up to a drachm daily, from twelve to thirty-six hours. (*Briquet.*)

---

* Some experiments have been made to determine the influence of quinia on the excretion of substances with the urine. Dr. Wm. A. Hammond, of the U. S. Army, found, as the result of his investigations in cases of intermittent fever, that the use of quinia was followed by a diminution of the uric acid in the urine, and an increase of the urea (*Am. Journ. of Med. Sci.*, April, 1858, p. 326); and the same result, as relates to the diminution of uric acid, was obtained by Dr. H. Ranke (*Lond. Med. Times and Gaz.*, May, 1857, p. 537). But we have, as yet, insufficient facts to justify any positive inference, as to its general physiological action, from its influence on this secretion. (*Note to the second edition.*)

In animals which have perished under the influence of quinia, no lesion has been discovered, as a general result, sufficient to account for the fatal effect. Almost invariably the pia mater has been found more or less injected; but not to such a degree as to account for the fatal issue, though the appearance may aid in the explanation of its mode of operation. It has already been stated that, in a few instances, traces of meningitis have been noticed. The probability is that, if any characteristic lesion be found, it will be in the nervous centres near the base of the brain, upon which the medicine appears mainly to expend its influence, so far as that organ is concerned. Perhaps a careful examination of these parts, by means of the microscope, might reveal some characteristic abnormal condition.

In relation to *Peruvian bark* itself, the effects are essentially the same as those of quinia; but, in consequence of its bulk, or of certain non-alkaline principles contained in it, as the cinchonic red and the yellow colouring matter, it is much more disposed to irritate the stomach and bowels. It often, therefore, nauseates, and occasionally causes vomiting or purging, especially if the alimentary mucous membrane is in an irritable state; and in some instances it cannot be borne on the stomach, in quantities sufficient to produce its characteristic effects on the system. When very largely given, it generally becomes intolerably offensive to the stomach; so that it is difficult to obtain from it the sedative and prostrating effects produced by excessive doses of sulphate of quinia; and, when such effects are observed, it is not always easy to discriminate between them, and the sympathetic effects of the attendant nausea. Hence, the highly important property of diminishing the force and frequency of the pulse long escaped attention, and became known only after the discovery of quinia. The bark differs also from its alkaloids in another particular; in its occasional tendency, namely, to produce constipation, resulting probably from the tannic acid it contains. This effect is of course evinced only in states of the bowels, in which they are not disposed to be irritated by it.

Cinchonia has been found to be identical in its effects with quinia, except that it is about one-third weaker; in other words, requires to be given in a quantity about one-third greater to produce the same result. Briquet, in his experiments, never obtained from it the effect upon the vision sometimes produced by quinia; but this was probably owing either to the insufficient number of trials, or to the insufficient amount employed.

Quinidia and *quinicia* appear not to differ from quinia, in their operation on the system, whether physiologically or therapeutically. In relation to *cinchonidia* and *cinchonicia*, their effects have not, so far as I know, been separately studied; but the probability is that they would be found to operate identically with cinchonia, to which they hold so close a chemical relation.

4. *Mode and Nature of Operation.*

It is probable that the tonic operation of quinia upon the digestive organs is chiefly direct; as it certainly possesses the property of local stimulation. This is evinced by the pain and inflammation, often followed by superficial sloughing, which result from its application, undiluted, to the surface of the skin deprived of the epidermis. The gastric and intestinal irritation, occasionally caused by it, is probably nothing more than an exaggeration of its legitimate tonic influence upon the alimentary mucous membrane. There is reason to suppose that the febriculous condition, sometimes attendant upon its action, is the result of the sympathetic extension of this irritation to the system at large. But the constitutional impression thus produced is not the normal and characteristic effect of quinia upon the system. The latter arises from the absorption of the medicine, and its direct contact with all parts of the body affected; and is in fact interfered with by any gastric irritation which may proceed from the quinia, because absorption is thus impeded. Nevertheless, it is not impossible that the tonic effect of the medicine on the digestive organs may depend, in part, upon its entrance, through the circulation, into the interior of their tissues, and the exercise there of an excitant influence upon their nutrition.

That the active principles of Peruvian bark enter the circulation can no longer be doubted. Several experimenters have detected quinia in the blood; and it may easily be recognized in the urine, a short time after its administration, by a simple chemical test. A solution of iodide of potassium, in which free iodine has been dissolved, throws down an orange-brown precipitate from the solution of a salt of quinia. In ordinary urine no such effect is produced; but, during the use of sulphate of quinia, the application of the reagent is followed by a precipitate as soon as the system becomes affected, and as long as it continues to be so.* The quantity which passes by urine is proportionate to that administered; and, as little or none has been satisfactorily detected in other secretions, it follows that most, if not all of the salt, is eliminated by the kidneys. It is an interesting fact, moreover, that the quinia ceases to appear in the urine soon after its observable effects upon the system have ceased. The inferences deducible from these facts are, *in the first place*, that Peruvian bark acts on the system through the medium of the circulation, and, *secondly*, that its action is dynamic, that is, upon the vital properties of the parts affected, and not through any chemical combination with the tissues, which would otherwise retain the alkaloid.

But are the effects of the medicine on the system at large the same as those upon the digestive organs? Is it a general as well as local tonic? Does it stimulate the functions of the brain, heart, and other organs which it reaches by the route of the circulation, as it is admitted to stimulate the stomach? These are questions of great importance, as they are not theoretical merely, but have a strong practical bearing. There are many who agree with the Italian contra-stimulant school, in believing that sulphate of quinia is a powerful direct sedative, especially in large doses, and consequently that it is applicable to cases of high excitement, and even of active inflammation. If, as others suppose, it is essentially stimulant, this application of it is certainly not indicated, and must often be highly injurious.

I believe that it is the general impression, and it certainly is my own, that, in *small doses*, quinia is essentially and universally tonic. Not only upon the digestive organs, but in all the parts to which it is carried by the circulation, its effects thus administered are to excite moderately the nutritive function, and probably in some degree also that of secretion. Through its influence upon the processes by which the blood is formed, it probably tends to augment the quantity of that fluid, and to render it richer. Thus, by its own operation upon the nutrition of the heart, and through the agency of the enriched blood, it gives greater energy to the contractions of that organ; and hence the fuller and stronger pulse, not unfrequently resulting from its moderate and continued use. It does not, however, appear, like the arterial stimulants, to excite the heart immediately into increased frequency of pulsation; and, when this effect is occasionally experienced, it is probably through sympathy with the irritated stomach or brain. In all the points just referred to quinia agrees with the simple bitters. But there is another in which it materially differs from that set of tonics; I refer to its action on the brain. The simple bitters may affect that organ through the enriched blood, or possibly by directly stimulating its nutrition; but its special functions are not immediately excited, and in no degree observably interfered with. Quinia, on the contrary, acts with a special predilection on the cerebral functions; stimulating them gently, and within the limits of tonic action, when given moderately; but, in excess, producing the effects of over-excitement or irritation proportionate to the quantity used. In small doses, this influence is not evinced by any striking phenomena; but it is no doubt felt, and contributes to give to Peruvian bark that pre-eminence over other tonics which it has so long enjoyed. But discrimination is necessary in order to an accurate understanding of its operation on the brain. Resembling in some respects the stimulant narcotics, it yet differs from them in the special seat of its action. Both obey the general laws of stimulation; that is, they at first increase the normal function of the excited part, then derange it, and finally, by a continuance of their influence, diminish or suppress it. But, while the cerebral stimulants or stimulating narcotics operate more or less upon the whole encephalon, and especially upon the seat of the intellectual and emotional functions in the cerebral lobes; quinia leaves these almost unaffected, and confines its influence more especially to the centres near the base of the brain; those, namely, of sensation, and those which control the organic functions of the system. Hence we seldom see mental exhilaration, delirium, or stupor produced by quinia; while excitement, disturbance, and depression of hearing or sight, and of the reflex muscular movements of circulation and respiration, are its constant results when taken in full doses.*

---

* The solution employed by Briquet for this purpose contained 2 parts of iodine, 8 of iodide of potassium, and 250 of water. He found the action of the test to correspond closely with the observable effects of the medicine upon the nervous system. Thus, after the exhibition of 8 grains of sulphate of quinia in one dose, a precipitate sometimes appeared in half an hour, though more frequently at the end of two hours; after 4 grains, in two or three hours; after 2.5 grains, if any appeared, it was not till the expiration of five or six hours. The length of time, therefore, before the appearance of quinia is inversely proportionate to the quantity taken; and the same rule holds in relation to the period at which the effects are felt. (*Trait. Thérap. du Quinquina*, p. 220.)

Another fact, noticed by the same experimenter, is that the quantity of the salt of quinia eliminated is directly proportionate to that introduced.

A third, also highly interesting, is that the elimination always ceases after a short time, generally little exceeding that during which the effects of the quinia persist. Thus, after a single dose of about 8 grains, the quinia disappeared from the urine in from 20 to 24 hours; after 80 grains taken during 12 hours, in about 40 hours; and after large doses taken for several days, in from 60 to 80 hours. (*Ibid.*, p 230.)

---

* In reference to the effects of quinia on sight and hearing, I recently had a patient who, under the full influence of the medicine, was affected with curious hallucinations, not only seeing either strange or familiar faces, but hearing unreal voices, sometimes from visible, sometimes invisible sources; and, as the patient was, on a moment's reflection, conscious that they were illusions, they were often sources of amusement. There was no fever, and no other evidence of cerebral excitement. The hallucinations vanished when sufficient time had passed for the elimination of the medicine. (*Note to the third edition.*)

Admitting quinia to be moderately stimulant, in small doses, to those cerebral functions which it specially affects, we have next to consider the question, whether the sedative effects undoubtedly produced by it, when largely given, are direct or indirect; that is, whether they proceed from an immediately depressing influence exerted by the quinia upon the encephalic centres, or are the consequences of a preceding state of excitation. To solve this question, it must first be determined, what are the immediate effects of a large dose of the medicine, sufficient to induce the ultimate prostration. Close observation upon the human subject and the lower animals has shown, I think, that so far as the brain is concerned, these effects are such as characterize excitation. The flushed face, the feeling of tension or fulness in the head, the sensitiveness to light, the buzzing and roaring in the ears, the vertiginous sensations, the involuntary muscular movements, the increased frequency of pulse and heat of skin, and the active delirium and convulsions which occasionally though rarely occur, are all proofs of stimulation and active congestion of the brain; and these proofs are still further strengthened by the fulness of the vessels of the pia mater, uniformly observed on post-mortem examination, and the evidences of positive meningitis which have been observed in a few instances. It is true that these phenomena of excitation are much less observable, when the same quantity is administered in small portions, at intervals of an hour or two; but, in this case, the stimulation from the several portions, not exceeding the degree of tonic action, is scarcely observable in the pulse, and subsides before being fully reinforced by the succeeding doses; while the secondary depression of the whole accumulates, and in the end becomes very obvious. The excitant effects of the large single dose may continue for two or three hours, when they gradually subside into a contrary condition, proportionate to the quantity taken, and, when this is in great excess, the prostration is in the end extreme. Now this is the ordinary and necessary result of over-stimulation; and it is altogether superogatory to imagine the existence of a directly depressing power in the medicine. The stimulation of an organ first excites its function; if it be continued and increased, the function is disturbed and becomes irregular; if still further increased, the organ is overwhelmed by the congestion induced, and its function is impaired or suppressed. The first excitement is thus followed by depression; and this is deepened through another physiological law, which determines that the excitability of a part is exhausted by over-exercise. Thus, after the first excitant effects of quinia above referred to have continued a short time, the cerebral centres become incapacitated for their duties through their congestion, and secondary exhaustion; and cease to send forth the influence necessary for the support of the functions over which they preside, or which they in any degree control. Hence the diminution or loss of hearing, the occasional loss of sight, the general feebleness of the muscular power, the trembling, the gradually diminishing frequency and force of the pulse, the coldness and pallor of the surface, and the universal prostration. Now this is a very different condition, in relation to therapeutic indications, from an apparently similar condition produced by a direct sedative to the nervous centres, or to the heart itself; and, though it might prove useful in certain cases if safely induced, yet, in determining upon the propriety of having recourse to it, reference must always be had to the possible danger of the great over-excitement and congestion of the nervous centres involved. This point will again be brought under discussion, when we come to treat of certain therapeutic applications of quinia, proposed on the ground of its sedative properties.*

In explaining the effects of quinia on the system, a new path of investigation has been opened by Dr. H. Bence Jones, through the discovery in the animal tissues of a substance strongly resembling quinia in its reagencies; not only exhibiting the same remarkable fluorescence in solution, but responding in like manner to various other tests of quinia. But much further investigation is requisite in order to form a satisfactory opinion of the relation of this new substance with quinia, and how far any supposed similarity or identity between them can have a bearing on the systemic influence of the cinchona alkaloid.

---

* Some experiments of Briquet upon dogs would seem to prove a direct sedative influence of quinia upon the motor power of the heart. By injecting quantities of sulphate of quinia in solution, varying from 7.5 to 30 grains, into the external jugular vein of dogs, he found the force of the heart's contractions, as measured by the hæmadynameter of Poiseuille, to be diminished in proportion to the quantity used, very slightly by the first quantity, and very greatly by the last, which caused the speedy death of the animal by syncope. In other experiments, in which similar solutions were made to enter directly the cerebral vessels, the brain was excited, and the force of the heart's pulsation considerably increased. (*Traité Thérap. du Quinquina.*) The inference from these results is that quinia is directly stimulant to the brain, and, through it, is capable of exciting the heart; while, introduced into the heart itself, it has a tendency to paralyze that organ. A great objection to these experiments, so far as the heart is concerned, is that, in order to produce the least depressing effect on that organ, the quantity of sulphate of quinia, introduced into the jugular vein, must produce a much stronger impregnation of the blood reaching the heart, than can be produced by any amount of the medicine swallowed, which is eliminated by the kidneys almost as fast as it is absorbed. The inference is, that no direct observable depression of the heart would follow the internal administration of quinia. But, even though we should admit the entire accuracy and relevancy of these experiments, they do not invalidate the force of the argument in the text, in relation to the use of quinia as a sedative. Whether the depression in the actions of the heart, produced by large doses, depends wholly upon the secondary depression of the brain, as supposed in the text, or partly upon that, and partly upon the direct action of the quinia on the heart, in either case the danger of an over-excitement of the brain, which the same experiments show to result from the medicine, must be encountered, whenever the sedative effect on the circulation is resorted to as a therapeutic agency.

5. *Injurious Effects and their Treatment.*

In ordinary doses, quinia is not apt to produce deleterious effects, unless through want of appropriateness to the pathological condition in which it may be prescribed; but, when very largely administered, it sometimes causes unpleasant symptoms from congestion or over-excitement of the brain, among which a greater or less degree of deafness is the most common. Generally this deafness subsides, with the other phenomena, in a period of time varying from a few hours to two or three days; but sometimes it persists much longer, at length gradually yielding; and, in very rare instances, has proved permanent and incurable. Cases are on record in which death has occurred from inflammation of the brain, under the excessive use of quinia; though there is reason to believe that there may have been, in these cases, either a strong predisposition requiring only a special cause to call it into action, or a certain amount of pre-existing inflammation, which was easily aggravated into fatal violence. Still, experiments upon animals have shown that, even in healthy conditions of the brain, encephalitis may possibly result from the abuse of this medicine. In all cases of over-excitement of the brain, the obvious remedies are leeching or cupping behind the ears, cold water to the head, a saline purgative not only to deplete and act revulsively, but to carry off any unabsorbed portion of the alkaloid, and, lastly, bleeding from the arm, if the symptoms should be urgent, and the pulse permit.

The irritation occasionally produced by quinia in the urinary passages, during its elimination, is said, in some instances where large doses have been taken, to have been aggravated into cystitis; and even retention of urine is asserted to have been produced by it.

Another danger from quinia is the great secondary prostration from enormous doses, which, in persons already feeble, may possibly in some instances prove fatal.* Experience has shown that, under such circumstances, stimulants are not only safe, but useful. Carbonate of ammonia I should prefer to the alcoholic stimulants, as it excites the heart with less effect on the brain; but, if this fail, recourse may be had to wine or other fermented liquor, and even to brandy, should the prostration be alarming. If much nervous disturbance, as tremulousness, convulsions, or delirium, attend the prostration, one of the salts of morphia may be employed. Giacommini found coffee useful in cases of cinchonic syncope which came under his notice. In all cases in which the salts of the cinchona alkaloids have been given too largely, tannic acid or an astringent infusion should be administered internally; for, though the tannate is not without effect on the system, it is certainly less rapidly absorbed than the soluble salts.

---

* It is strange, however, considering the powerful effects often produced by comparatively moderate doses, how far the quantity may be increased without fatal results. The case of Giacommini has already been referred to (see *page* 235). Another is mentioned by Briquet, in which 41 grammes (about ten drachms and a half) were taken in the course of a few days. The patient lost for a time sight, hearing, and speech, and became as cold as a corpse, but nevertheless recovered. *Trait. Thérap. du Quinquina*, p. 490.)

6. *Therapeutic Application.*

It is an undecided question, whether Peruvian bark was known as a medicine to the aborigines of S. America, before the discovery of the country by Europeans. Both sides of the question have the support of high authority; the affirmative being maintained by Ruiz and Joseph de Jussieu, and the negative by Humboldt. Leaving aside some absurd stories in reference to the manner in which the remedy was discovered by the natives, and the mysterious secrecy said to have been observed by them in relation to it, the weight of probability appears to me to be in favour of its indigenous employment, long before the invasion of the Spaniards. The traditions in the country were to this effect; and it scarcely seems probable that a people, so civilized as the ancient Peruvians, should have overlooked a remedy so abundant, so easy of access, and so vitally important in the treatment of the fevers which must have prevailed among them. That among the ignorant and degenerate natives, at the time of the visit of Humboldt, violent prejudices should have existed against the bark, and an idea been entertained that it was poisonous instead of remedial, can hardly be admitted as an argument against this view of the subject; as a similar prejudice may be found among the vulgar, even in the most enlightened countries, where the remedy is much employed, and highly valued by the intelligent.

Peruvian bark, either of itself, or in some one of its preparations, is calculated to meet several distinct therapeutic indications; 1. as a simple tonic, 2 as an antiperiodic or anti-intermittent, 3. as a supersedent, and 4. in reference to its secondary sedative properties. Of these I shall treat severally, premising that not unfrequently two or more of these indications are presented conjointly in the same disease.

1. As a Simple Tonic. For this purpose, the medicine is employed in small doses, repeated several times a day. Difference of opinion exists as to the preferable form of administration. Some suppose that the tonic property resides mainly, if not exclusively, in the alkaloids; others, that it belongs essentially to other principles in the bark, the alkaloids having little or none of it; while a third opinion, admitting its existence in quinia,

cinchonia, etc., maintains that the colouring matters, tannic acid, etc., associated with them in the bark, so modify their influence as to render the conjoint operation of all considerably more effective than that of the alkaloids alone. My own conviction, derived from no little experience with the different forms of preparation of Peruvian bark, is, that its medicinal powers reside almost exclusively in the alkaloids, and, though the form of combination in which these naturally exist may somewhat modify their effects, by influencing their acceptability to the stomach, or the facility of their absorption or elimination, yet that the bark itself, wholly deprived of them, would be nearly if not quite medicinally inert and useless. The general experience too corresponds, I suspect, with my own; as quinia and its associated alkaloids have to a considerable extent superseded, even in reference to tonic effects, the use of bark, and of the various preparations most completely representing it.

The medicine may be used in *simple debility of the digestive organs, or dyspepsia.* Bark, in substance, is too apt to nauseate and oppress the stomach to be employed advantageously for this purpose; but recourse may be had to the extract, or one of the liquid preparations, especially the compound infusion of the U. S. Pharmacopœia, which, in great debility of the stomach or system, may sometimes be usefully combined with the simple or compound tincture. Sulphate of quinia, however, is, upon the whole, the most convenient preparation. Still, it is in no respect superior, in this affection, to the simple bitters; while it is more apt to oppress the stomach, and is, therefore, comparatively little used.

In *general debility*, however, it stands at the very head of the tonics. It probably owes its superiority, in this condition, over the simple bitters, to the greater universality of its action. The latter medicines, though stimulant to the digestive, blood-making, and nutritive functions, have little influence over the nervous centres. Quinia acts energetically upon these centres, and extends, through them, independently of its direct influence upon the tissues, a powerful support to the weakened organic functions.

In the *debility* of convalescence it acts very favourably. In pure *anæmia*, when the morbid condition exists specially in the blood, without obvious deficiency in the digestive or nutritive powers, or in nervous excitability, as often happens in chlorosis, quinia does little good; the appropriate tonic in such cases being iron. But, in that debility of all the functions which is apt to follow the agitations of acute febrile and inflammatory diseases, and from which it often happens that the unaided system rises slowly and with difficulty, no medicine is probably more efficient; and, if along with this condition there is a relative deficiency of the red corpuscles, it adds greatly to the effectiveness of the chalybeates.

When debility is associated with any organic mischief, as in the ulcerative condition left by inflammation and gangrene, the system is sometimes so prostrated as to be unable to carry on the reparative process, and ultimately sinks unless sustained. The tendencies are towards health, but the power to act duly is wanting. Under these circumstances, the preparations of Peruvian bark, in connection with a nutritious diet, are highly important.

When debility is produced or maintained by temporary exhausting influences, as by *profuse suppuration, excessive secretion*, or *passive hemorrhage*, it is often of the utmost importance to support the strength until the discharge has ceased; and a strong indication is offered, in such cases, for quinia or bark in some other shape, which may often be advantageously combined with opiates and alcoholic stimulants, especially the fermented liquors. Examples of this kind, dependent on profuse suppuration, we have in the advanced stages of *extensive inflammation of the ordinary character*, whether of the internal organs or external parts; in *scrofulous abscesses;* in *erysipelas affecting the subcutaneous tissue;* in *metastatic abscess, purulent infection, pyogenic fever*, or *suppurative phlebitis;* and in the *last stage of confluent smallpox*, in which large portions of the surface are bathed in pus, and subcutaneous purulent deposits sometimes form in enormous quantity.

Of exhaustion from excessive secretion we have examples in the effects of *colliquative sweats, diuresis*, and *diarrhœa*, and of *copious mucous discharges* from the *bronchial tubes* and *urinary passages*. In these cases, quinia sometimes acts happily, not only by sustaining the system under the exhaustion, but by correcting the excessive discharge, which itself not unfrequently depends on a pre-existing debility and relaxation. But astringents are generally still more useful here than quinia, which may often be advantageously associated with them; and it is probable that the infusion, decoction, tincture, or extract of bark may be more useful than the alkaloids, in consequence of the tannic acid they may contain.

The same remark is applicable to *passive hemorrhages*, which at once depend upon and increase debility, and in which the conjunction of astringents with the preparations of bark is often indicated.

Another condition of debility, in which this medicine is highly serviceable, is that produced and kept up by some directly depressing agency, independently of any exhausting discharge. Such are all those conditions of the system in which *extensive gangrene* has taken place, or even a small degree of it, if in one of the internal and vital organs. How it is that the connection of a mortified part with living tissue should produce general prostration is not always very evident; but such is certainly the case, even where there has been no preceding debility. When the debility gradually ensues, and is attended with typhoid symptoms, there has probably been absorption of the deleterious matters resulting from putrefaction, and a consequent contamination of the blood. But frequently the result is too sudden to admit of this explanation. A part dies; and almost instantaneously the pulse becomes feeble, the skin cold, the countenance pale, shrunken, and ghastly; and, though reaction to a certain extent may take place, yet the energies of the system are still depressed, and continue so more or less until the offending cause is removed. Possibly a depressing effect from the dead matter upon the adjoining nerves may be reflected to the system, through the nervous centres, in the same manner as local irritation. But, however produced, the debility exists, and often requires the interference of tonics and other stimulants to support life, and give the parts power to throw off the offending cause. Certainly, among the tonics there is none so efficient for this purpose as cinchona. So beneficial is it, that an idea formerly prevailed that it possessed a positive and peculiar property of checking or obviating mortification and putrescency. At present, however, this idea is not admitted. All that the bark can do is to sustain the failing energies; and this it is perhaps better able to do than others, because of its stimulating influence on those very nervous centres through which the depressing impression is propagated.

In the gangrenous cases in which a pre-existing condition of system, or depraved state of the blood, has caused the mortification, there is a double indication for the tonic. Hence, the preparations of bark have always been among the most approved remedies in *anthrax*, *gangræna oris*, *malignant sore-throat* with or without scarlet fever, and *erysipelas with sloughing of the subcutaneous tissue.*

Another large list of diseases, in which debility, depending on a direct sedative influence, indicates the use of bark until the depressing cause shall cease to act, are the typhoid affections. In these, either the morbific cause itself, or the depraved state of the blood resulting from it, acts with a special influence on the brain, producing dulness, stupor, low delirium, and other evidences of cerebral debility. Cinchona, therefore, is specially called for, both for its excitant action on the nervous centres, and the rapidity with which it acts. *Typhus fever*, *the advanced stages of typhoid* or *enteric fever*, *petechial* or *spotted fever*, *scarlatina* particularly of the *anginose* and *malignant* varieties, *malignant smallpox* and *erysipelas*, and even the phlegmasiæ when they assume the typhoid condition, *as typhoid pneumonia* and *dysentery*, are often usefully treated with this pervading and powerful tonic. Though of itself insufficient to support life in many of these cases, and therefore requiring the aid of more potent stimulants, as carbonate of ammonia, opium, and the alcoholic liquids, it gives a durability of impression, and power of resistance, not equally obtainable from these agents, and, therefore, cannot be fully replaced by any one or all of them.

In protracted diseases, particularly those of a febrile character, though perhaps sthenic in the beginning, the vital forces are gradually impaired by their over-exercise, and a state of debility ensues requiring tonic treatment. Here too the preparations of bark are the most efficient. It is highly important to know when exactly the period for this treatment has arrived; for, if prematurely employed, it may injuriously aggravate the excitement. I have noticed that the occurrence of *night-sweats*, under these circumstances, offers one of the best criteria of the new condition. When a patient with a febrile disease, not having been especially affected with diaphoresis, *begins to sweat profusely whenever he sleeps, and only then*, I consider the symptom as an almost sure sign of debility; and quinia, though previously contraindicated, may now be used with safety and advantage. This condition is quite different from the typhoid. In both there is debility; but in the latter, it is connected essentially with depravation of the blood; in the former, it is merely the result of an over-exercise and consequent exhaustion of the vital forces, and the blood is no otherwise diseased than as it may be deficient in quantity, either considered generally, or in relation to the red corpuscles. My attention has been particularly directed to the condition as it occurs in *acute rheumatism*, in which it is not very uncommon, though the disease may still be associated with considerable pain and swelling in the joints. Whenever night-sweats take place in that disease, I invariably employ quinia, and almost uniformly with favourable effects, not only checking the excessive sweating, but very much ameliorating if not promptly curing the rheumatism itself. I have been long in the habit of employing and recommending this practice; for many years, indeed, before the recent revival of an old method of treating acute rheumatism by Peruvian bark.

Various derangements of health which have been classed together under the designation of *cachectic*, the only common characters of which are chronic debility, and a not well understood depravity of system, in which the blood is probably always involved, such as *syphilis* in its advanced stages, *scrofula*, and various obstinate cutaneous eruptions, including *ecthyma, rupia*, and *impetigo*, are not unfrequently benefited by quinia, in conjunction with certain alterative remedies, as iodine, mercury, and arsenic.

Under this head may perhaps also be ranked the use of quinia *in enlarged spleen*, especially when following miasmatic fevers, or occurring in malarious regions. Some ascribe the efficacy of the medicine, in these cases, to a property which they suppose it to possess of directly contracting the spleen. But quite as probably it is ascribable to an alteration, under the tonic influence of the remedy, of that condition of system, and especially perhaps of the blood, which originated and sustains the affection. In many instances of enlarged spleen of a different origin, even when there is no reason to suspect cancer, tubercle, or other incurable heterologous formation, quinia proves, as I have often witnessed, wholly inoperative.

2. As an Antiperiodic, or Anti-intermittent. No remedy approaches Peruvian bark in antiperiodic powers. There is scarcely a doubt that, for its peculiar properties in this respect, it is indebted exclusively to its alkaloid constituents, and that everything which bark can do, can be effected by quinia. Indeed, in consequence of being less offensive to the stomach, the latter is the more effective of the two, where a strong impression is necessary, or when the affection is complicated with gastric irritability. In all *regularly intermittent or periodic diseases*, quinia may be considered as an almost certain remedy; at least I do not remember to have met with a case which has not yielded to it, since the management of this medicine has been well understood. But it is not all diseases occurring paroxysmally that belong to the category here referred to. To come under the head of regular intermittent diseases, the affection must occur about the same hour, at the interval of a certain number of days, one, two, or more, without any positive or recognizable disease, in the period between the paroxysms, by which they can be reproduced. In other words, the complaint must be at once idiopathic, and regularly periodic. Hectic fever, therefore, though it has paroxysms closely resembling those of intermittent fever, does not belong to the class referred to; because it depends upon an ever-present organic source of irritation, and its paroxysms are irregular in their recurrence. Epilepsy and hysteria are equally excluded, though both paroxysmal, because often dependent on a constant though perhaps concealed lesion, and almost always more or less irregular. But even these affections, or imitations of them, when purely functional, and occurring at regular periods of one or a few days, will yield for a time to the antiperiodic treatment. Indeed this treatment is, in its nature, essentially temporary; its only effect being to guard the system against the recurring paroxysms, not to secure future immunity, when its direct influence has ceased. If, therefore, there should be some cause in operation capable of inducing a paroxysm of the disease, the patient is still liable to an attack after apparent cure, supposing the direct influence of the remedy to have been withdrawn. Hence, even in ordinary intermittent fevers, it very frequently happens that the paroxysms recur, at a somewhat varying period, after the suspension of the antiperiodic treatment. All that we can accomplish, then, by this treatment, is to prevent the recurring paroxysms so long as the remedy acts. If, in the mean time, the cause cease to operate, or the susceptibility to its influence no longer exist, when the chain of morbid association, or the force of habit is broken, a permanent cure is effected; if not, the disease is liable to return, and may continue to do so until the cause is at length removed, or the sys-

tem becomes insensible to its influence, as it does in time to noxious agencies in general, when not fatal in their effects, or applied in increased quantity or force.

Intermittent fever is a disease in which quinia exhibits, probably, its most extraordinary powers. Before the discovery of Peruvian bark, some of the forms of this affection were extremely embarrassing to physicians, and an obstinate quartan was scarcely less dreaded than pulmonary consumption. Afterwards it was found in general to be very manageable under the new remedy; but cases were now and then met with which resisted its influence, in consequence sometimes of insurmountable obstacles to its administration in the ordinary quantity, or to its retention when administered, and sometimes of the impossibility of introducing into the system a quantity large enough to meet the requisitions of the case. But, since the introduction of quinia into use, the disease may be considered as completely under command, so far at least as regards any single attack. The only requisitions are, that the remedy be administered in sufficient quantity, and at the proper time. If upon trial a certain amount is not found to answer, it must be increased; and no limitation should be put to this increase, except the production of the desired effect, or a reasonable apprehension of serious mischief to the patient. The general rule is to give enough to affect the cerebral centres decidedly, as indicated by the buzzing or roaring in the ears, or by a greater or less degree of deafness.

The question at once presents itself, whether any previous preparation is necessary, and, if any, what? Formerly, it was customary to anticipate the antiperiodic by an emetic. Experience has shown this to be unnecessary in the vast majority of instances. Should, however, the attack surprise the system with the stomach loaded, and evidences of gastric irritation at the same time exist, it might be advisable to aid nature in getting rid of the offending matter, by means of warm water, or warm chamomile tea drank freely, or if necessary by a dose of ipecacuanha. Ordinarily the only preliminary measure desirable is the evacuation of the bowels. In urgent cases, where it is important to produce the antiperiodic impression as soon as possible, even this may be dispensed with, and the administration of the quinia commenced at once. I think, however, that it is generally best to begin with a cathartic, in order to remove any possibly offending matter from the bowels, and unload the portal circulation, and thus promote the absorption of the medicine. If the liver is torpid, a portion of calomel or blue mass should be given with the cathartic.

Another question to be decided is, how far the treatment is to be influenced by any existing complication of the intermittent fever. Some have supposed that a coexisting inflammation contraindicates the use of quinia, and that the inflammation should be subdued before commencing with the administration of that medicine. I have long been of a contrary opinion. If the inflammation is insufficient to sustain a febrile excitement between the paroxysms, that is, to convert the intermittent into a remittent, it is either periodical itself, and obeys the laws of periodical diseases in general, or is insufficient to be materially aggravated by the stimulant properties of sulphate of quinia. Indeed, the general stimulation of the paroxysm is vastly greater than that of the medicine, and consequently much more likely to aggravate the inflammation. It would seem clear, therefore, that by interrupting the paroxysms we must, instead of aggravating, really relieve the inflammation, by removing the most powerful source of excitement. If theory justifies the use of the antiperiodic under these circumstances, experience is no less decidedly in its favour. I have never known the inflammation, attendant on a perfect intermittent, to be increased by the use of quinia; I have not known it to prevent the antiperiodic medicine from having its due effect; while I have observed that the inflammation is mitigated, and indeed often ceases, almost immediately upon the interruption of the paroxysms; and I believe that my experience, upon these points, coincides with that of the great majority of practitioners in the miasmatic districts of the United States. I am, indeed, prepared to go further, and to state that the same thing is true, in a great degree, even when the inflammation is sufficient to maintain some fever between the paroxysms; but, in such cases, I should premise blood-letting, general or topical, or both, when apparently called for by the severity of the local disease, and permitted by the state of the pulse. The same reasoning applies here as in the former case; the stimulation of the paroxysm is vastly greater than that of the medicine; and experience equally confirms its justness by the result. There are only two instances, in which I would admit of an exception to the general rule; namely, when the cerebral centres, which are especially susceptible to the stimulant influence of quinia, and the mucous membrane of the stomach, which is liable to be irritated by it, are the seat of the inflammation; and, in the latter case, though I might not administer the medicine by the stomach, I should not hesitate to give it freely by the rectum or hypodermically. If inflammatory complication offer no contraindication to the use of quinia in intermittent fever, I know of no other impediment, unless it may be *active cerebral congestion*, which should if possible be removed, prior to its employment.

Much has been said of the proper period for the administration of quinia. Some give it indiscriminately at all periods of the disease, without reference to pyrexia or apyrexia; but the great majority confine its employment to the intermission, and, as I think, correctly, unless in certain cases of pernicious fever, where it is of the utmost importance that the approaching paroxysm should be prevented, and there is reason to apprehend that the intermission may be too short for the purpose. In the first place, there is no necessity for giving the quinia during the paroxysm; and, secondly, though it may often be given with impunity, yet there is always some risk of aggravating into positive inflammation any pre-existing tendency to it in the brain or the stomach, or of causing effusion of blood in cases of active cerebral congestion. In the true *pernicious variety*, in which the great danger arises from defective or perverted innervation of the vital organs, and there is little tendency to active congestion or inflammation, the risk from quinia in the paroxysm can scarcely be said to exist, while the loss of time in withholding it may be fatal. There is one caution, however, which should be observed in the use of quinia during the pernicious paroxysm; namely, never to give it so largely, in the cold stage, as to induce its secondary sedative effect, and thus add to the prostration, which is often itself very alarming, and not unfrequently fatal. Admitting then that, as a general rule, the medicine should be given only in the intermission, we have still to determine at what time, during this period, we are to begin with it, and when to suspend it. Without referring particularly to the various shades of opinion among authors on this point, I will merely state my own, based upon what is known of the action of quinia, and upon personal observation, that the best plan is to commence immediately after the cessation of the paroxysm, and to continue, with repeated doses, until within about an hour of its expected recurrence, so that, at the time referred to, the system may be under the full influence of the medicine.

I prefer the exhibition of the sulphate of quinia in small doses, repeated at intervals of an hour or two, to the use of the full quantity, required for a single intermission, in one or a very few doses. We thus incur less risk of irritating the stomach, or over-exciting the brain, while we have it in our power to modify the dose, if the effects should be unexpectedly and unnecessarily severe. The absorption is probably also more complete, and the whole amount necessary for the required effect diminished. But there are circumstances which justify, and even demand a departure from the general rule; as when the intermission is very short, or when it occurs at night, so that a frequent administration might interrupt sleep, and in this way injure the patient. In such cases, the whole quantity may be given in one, two, or three doses; care being taken to throw the medicine mainly into the earlier period of the apyrexia; as, if withheld until immediately before the paroxysm, time is not allowed for its absorption and full operation, while, even if confined entirely to the earlier period, as its action continues for many hours, this may be in full force at the time required.

Used in the method above pointed out, sulphate of quinia is capable of interrupting almost any case of intermittent fever, from the mildest to the most violent. But different quantities are required in different varieties of the disease. The purely irritative intermittent, occurring independently of miasmatic influence, and sometimes ceasing spontaneously after a few paroxysms, may usually be checked by from six to twelve grains, given in each intermission. The ordinary miasmatic intermittent, though it will sometimes yield to the same quantity, is much more effectively treated with from twelve to twenty-four grains in the same time. The pernicious form of the same affection cannot be trusted to less than from twenty to sixty grains. The great rule, in the administration of the medicine, is to give enough to produce an obvious impression on the brain, and to maintain that impression until every vestige of a paroxysm shall have ceased. In many instances, the disease is at once arrested, and there is no return of the paroxysm, especially if the required impression has been produced some hours before the period for its recurrence. More frequently, perhaps, one additional paroxysm occurs, though with mitigated severity, and the succession is arrested at the second. Rarely does the disease pass on to a third. Sometimes, instead of having been quite set aside, the paroxysm returns in a very mild or partial form, without a distinct chill, and with very little fever, and altogether so slight that, in itself, it would scarcely attract attention. It is important, however, as indicating that the disease is not yet arrested, and that, unless the impression of the medicine is maintained, the paroxysms may again assume their original severity. It is not impossible that a quotidian, which has been once interrupted, may return on the following day as a tertian; and, in like manner, a broken tertian may assume the quartan type. These results may be guarded against by continuing the quinia beyond the period for the tertian or quartan paroxysm; though they are so rare that this caution may generally be dispensed with, and the plan only put in force in cases presenting this peculiarity. As a general rule, therefore, the medicine may be omitted immediately after the complete interruption of the paroxysms. It is of no advantage to continue with it regularly afterwards, with a view to prevent the septenary or bi-septenary recurrence of the paroxysms, to which the disease is liable; for a smaller daily amount than that originally necessary for arresting the disease, cannot be depended on for preventing these returns; and to persist in the use of so large a quantity may render the system at length insusceptible to its operation. The best plan for checking the weekly or bi-weekly returns, the latter of which are by far the most common, is, I think, to ascertain at what period, in any particular case, the paroxysm is disposed to recur, and to anticipate this by giving the patient, during the two days preceding that period, as much as was at first necessary to interrupt the disease; and to pursue this course every week afterwards for one or two months, or longer if necessary. The interrupted use of the medicine prevents the system from becoming accustomed to it; and, after a time, the disposition of the disease to recur ceases.

Writers speak of *latent intermittent fever*, in which the disease is masked under other forms. Thus, there may be a chill and perspiration, without fever, or a headache with loss of appetite, malaise, etc., recurring at the regular day and hour; or the effects of the cause may be shown in an attack of violent periodical neuralgia, or some special local affection, as diarrhœa or dysentery; and all such cases will yield to the antiperiodic treatment quite as readily as the regular disease. There seems, however, to be no necessity for considering these affections as masked intermittent fever. They are simply different morbid results of the same cause, and, like intermittent fever itself, are not exclusively of miasmatic origin, but may result also from other causes. But, whatever may be their source, they are equally amenable to the antiperiodic treatment.

Intermittent neuralgia is probably, next to intermittent fever, the most prevalent form of regular periodical disease. It may attack almost any part of the body, internal or external. As I have seen it, however, it is most common in or about the eye. Sometimes there is reason to believe that it is the effect of marsh miasm; but I have known it much more frequently quite independent of this cause. It is often probably of a rheumatic or gouty character, sometimes apparently the result of debility, occurring in the convalescence from other diseases; but quite as often, its source cannot be satisfactorily traced. I have never witnessed a case of this kind, if unconnected with organic disease, which has not yielded to sulphate of quinia. The ordinary doses of this medicine used in intermittent fever will often cure it; but they will often also fail. Double or even triple the quantity may be necessary to produce the desired effect.

Intermittent headache, especially hemicrania, may be considered as closely analogous with neuralgia, and is treated in the same way. But organic lesions of the brain are not unfrequently attended with severe pain in the head, assuming a somewhat regular periodical character, and liable, without caution, to be mistaken for pure functional neuralgia. In these cases, quinia may sometimes afford partial relief; but it is often quite powerless, at least in any quantity in which I have ventured to prescribe it; and, I believe, may do harm by over-exciting the already irritated nervous centres.

Rheumatism and *gout* are not unfrequently intermittent, in their nervous forms, whether as neuralgia, or painless disorder of function; and sometimes, also, in their inflammatory state. In either case, they yield in general readily to quinia.

The various *neuroses* occasionally assume the same regularity of recurrence. *Epileptic* convulsions, in general so intractable, may be treated with quinia with good hope of success, when they occur regularly, for any length of time, at the same hour daily, or every other day.

The same may be said of *hysteria*. *Cramps, internal spasmodic affections, asthma, nervous cough*, and *amaurosis*, are other complaints occasionally periodical in their character, and, in that state, curable by the great antiperiodic remedy.

Hemorrhages are said also to be sometimes regularly intermittent, and remediable in the same way.

The fact is undoubtedly true of certain complaints of an apparently *inflammatory character*. Among these, *ophthalmia* is mentioned; but, considering the frequency of neuralgia of the eye, I am disposed to think that these cases of apparent inflammation are little more than active congestion, sustained by the extreme nervous irritation, and subsiding when that ceases. I have repeatedly seen *diarrhœa* periodical, and in that condition yielding to quinia; but it is not always easy to determine whether the affection is inflammatory, or merely irritative. One of the most apparently violent attacks of *dysentery* which I ever saw proved to be regularly periodical. The case occurred in the Pennsylvania Hospital. At my first visit, the man was seemingly very ill, complained excessively of pain, was constantly going to stool with the characteristic dysenteric discharges, and seemed to me to be in great danger of his life. Next day he was almost well; and I supposed that the disease had yielded to the measures employed. On the following day, however, it returned with all its former violence, and subsided again as before. There were several similar paroxysms. Convinced that it was periodical, I gave sulphate of quinia very largely in the intermission, and almost immediately checked the disease. But the probability, I think, is that, in all these regularly intermittent inflammations, the nervous element of the disease is predominant, and that the vascular disturbance is directly dependent upon it. In many cases, however, of apparent intermittent inflammation, especially of the lungs, the local affection is a mere appendage of a miasmatic fever, being lighted up by the general vascular excitement of the paroxysm, acting probably upon a predisposition to inflammation in the organ affected. But, whether its origin be as here supposed or not, it yields with great facility to quinia, when there is proof that the inflammation is quite absent during the period of the apparent intermission.

In *regular remittent diseases*, quinia is scarcely less efficient than in intermittents. In this category, however, are not included all affections having the remittent character. In consequence of the varying excitability of the system, almost all complaints, perhaps it may be said all complaints of any considerable duration, are more or less remittent, even though the cause may be constantly operating. But to constitute a regular remittent, in the sense here intended, there must be a paroxysm recurring daily, or every other day, at regular intervals; and, though the morbid action may continue, in a moderated degree, throughout the intervening period, yet it is rather a prolongation of the paroxysm, than a continuous and sustained effect of the cause. It is as if the cause operated only paroxysmally, and the disturbance of system produced by it did not subside completely before the period arrived for the recurrence of its action. These diseases, then, are not continuous affections, undergoing occasional exacerbation and remission; but consist of successive paroxysms, more or less intercurrent. They are closely analogous to intermittent disease, and are submissive to the same antiperiodic treatment.

The most important of these diseases is the *miasmatic remittent*, or *common bilious fever*. In this complaint, sulphate of quinia is a most efficient remedy. Whenever a decided remission is observed, after due evacuation of the bowels, and of the stomach if necessary, it may be given in quantities similar to those administered in intermittent fever, and will not often fail. In the pernicious variety of remittent fever, or when pernicious symptoms supervene in a case before simple, it is all-important, and, indeed, is the only remedy on which reliance can be placed. As in the pernicious intermittent, the quantity should be double, or even triple that given in the milder form of the disease. In this affection, it is of vast importance that no time should be lost. The next paroxysm may very possibly prove fatal, unless prevented. Nothing, therefore, should be allowed to interfere with the use of sulphate of quinia, upon the first occurrence of signs of remission; and sometimes it might be advisable not to wait for this period, but, when the nature of the disease is well ascertained, to have recourse to the antiperiodic, by anticipation, even in the paroxysm; for the tendency here is not to active congestion or inflammation, but rather to nervous prostration and passive congestion, and there is little probability of serious injury to the brain, or other vital organ. In some instances, it is difficult to retain the remedy, on account of great irritability of stomach. It should not be omitted on this account, but given notwithstanding, in the hope that a portion at least may be retained; and its retention may be aided by the simultaneous administration of opiates, and by the application of a sinapism to the epigastrium. The remedy should also, under such circumstances, be additionally employed as an enema with opium, and as an application to the surface of the body by the endermic method; or, what is still better, by injection into the subcutaneous areolar tissue.

In *regular remittent neuralgia*, also, the best effects may be expected from sulphate of quinia, given in the same manner as in the intermittent form of the disease.

Preventive Influence. Upon the same principles as those on which periodical diseases may be cured, they may also be prevented by sulphate of quinia. There is no prophylactic measure against the miasmatic fevers at all comparable in efficacy to the use of this medicine. It seems reasonable to suppose that an impression on the system, such as prevents the return of the paroxysms, would prevent the occurrence of the first. Experience has established the correctness of this inference. All that is necessary is to give, twice every week, in divided doses, a quantity equal to that required for the interruption of the disease when formed. From ten to fifteen grains, in doses of two grains every two hours, will probably answer the purpose. I am not sure that the same amount taken weekly will not be sufficient, considering the tendency to septenary periods which characterizes the relapses of the disease.

In the *irregular intermittent diseases*, such as *hectic fever*, for example, sulphate of quinia, given in the same manner as in regular intermittents, will often check the paroxysms; but cannot be relied on even for this purpose, and is generally quite inadequate to the cure. The cause of these affections is generally continuous in its action, and is always, therefore, lying in wait to renew its assaults, though sometimes temporarily restrained. In hectic fever, the nervous centres, through which the sources of irritation operate in producing the paroxysm, may be rendered insensible for a time to their influence; but, as soon as the protective force is withdrawn, the cause again operates; and, if the quinia be given constantly, the system at length becomes insensible to its effects, and its remedial power ceases.

Nature of the Antiperiodic Action. Various theories have been broached to explain the antiperiodic effect of Peruvian bark. Most of them are scarcely deserving of notice. One of the most plausible, in reference to the miasmatic intermittents and remittents, is that the alkaloids have the property of neutralizing the poison in the system. But this is not tenable; as quinia cures the irritative intermittents even more readily than the miasmatic; and, if there be any disposed to deny the existence of the former affection, the argument will still hold; for intermittent neuralgia, which often occurs where there can be no possible suspicion of the influence of marsh miasms, even in the midst of cities the air of which serves as a protection against these miasms, will yet almost invariably yield to the same remedy.

I know no better explanation of the antiperiodic property, than that which supposes it to depend upon the powerful influence exercised by the remedy upon the nervous centres, through which probably the paroxysms are produced. Every consideration, in connection with the peculiarities of regular intermittent diseases, leads to the conclusion, that the paroxysms are caused by an influence acting through the cerebral centres, without which the result would not take place. Now, if these cerebral centres can be preoccupied by a strong impression from some other source, they may be rendered insensible to the morbid influence, and the paroxysm, therefore, is set aside. Quinia is characterized by its disposition to act energetically upon certain nervous centres, which are probably the same as those through which the cause of the disease operates. Quinia, therefore, interrupts the succession of the paroxysms; and, as they are probably sustained, in part at least, either by habit, or by some chain of morbid action passing insensibly from one paroxysm to the succeeding, the interruption is either permanent, or continuous until the original cause may reassume, in some mysterious way, its original activity, and produce a relapse in the now unguarded system. It is obvious that this explanation of the antiperiodic power of remedies implies an identity with that next to be considered; namely, the property of supersession; but, as the explanation is only conjectural, it is deemed best to treat of these two therapeutic agencies distinctly.

3. AS A SUPERSEDENT. What has been stated above explains the meaning attached to this term. It simply implies that the medicine so named has the power, by insinuating an action of its own in any part or organ, to displace disease previously existing in that part or organ, or to exclude it if not already established. It is known that quinia acts powerfully on the cerebral centres, especially those of the organic functions, and produces in those centres an impression of considerable permanence. The probable influence of such an impression in preventing the return of regular periodical paroxysms has been referred to. It is evinced also, though much less certainly and strikingly, in the prevention of irregular paroxysms of various kinds, and even in the relief of existing disease occupying especially the nervous centres, or acting through them, though not necessarily paroxysmal. Upon this principle, we may explain the occasional efficiency of sulphate of quinia in *irregular neuralgia*, when given very freely. In *chorea, functional epilepsy, hysteria, spasmodic asthma*, and the advanced stage of *pertussis*, it has sometimes been used advantageously; and it is said to have proved efficacious, in large doses, even in *tetanus*. Associated with infusion or oil of valerian, I have been much in the habit of using it in certain forms of nervous headache, imitating an old practice taught me by the late Dr. Jos. Parrish, in which Peruvian bark was used for the same purpose, with the same addition. Much efficacy in the cure of *nervous* or *sick headache* is claimed, by MM. Debout and Serre, for a combination of sulphate of quinia and digitalis; forty-five grains of the former and twenty-two of the latter, being made with syrup into thirty pills, of which one is to be taken every night for at least three months. (*Bullet. de Thérap.*, lviii. p. 311.)

4. AS A SEDATIVE. It will be recollected that I consider the sedative effect, produced by large doses of quinia, as essentially secondary; being always preceded by a longer or shorter period of excitement in certain cerebral centres, and probably dependent, at least in some degree, on this previous excitement, overwhelming, and as it were paralyzing these centres, and disabling them from extending their normal influence to the organic functions generally. In reference to this sedative property of quinia, it would seem to be applicable generally to diseases of over-excitement, not connected with active congestion, inflammation, or pecu-

liar excitability of the brain. Some, who believe in the direct sedative power of the medicine, do not admit even this exception. By these it is recommended in all inflammatory affections, even those of the encephalon; but experience has shown that it may prove very injurious, and even fatal, in such cases. The quantity requisite for the production of the secondary depression varies from fifteen to sixty grains daily. From a less amount, there might be danger of obtaining the direct stimulating effects of the medicine. The following are the complaints in which quinia has been especially recommended as a sedative.

Fevers. There can be no doubt that large doses of quinia will often control febrile phenomena, reducing the frequency and force of the pulse, diminishing the heat and dryness of the surface, and sometimes even relieving headache and delirium. Carried far enough, it will suppress all signs of over-excitement, and may even bring on great prostration.

In *remittent miasmatic fever* it is thus employed, especially in our Southern and South-Western States, very soon after the commencement of the disease, before a remission has become decidedly established, and even in the height of the paroxysm. There can be no doubt, from the abundant testimony on the subject, that, thus given, it will often speedily put an end to the febrile phenomena by its sedative operation; while, through its antiperiodic powers, it prevents a return of the paroxysms, and thus cures the disease. The effects are, in very numerous cases, so prompt and happy, and the injurious results comparatively so few, that the practice has become very popular, and, in some districts, almost exclusive. But, if my views of the action of quinia in these cases are correct, it is not without its dangers. Should active congestion, or positive inflammation of the brain, complicate the disease, it might be fatally aggravated, especially if it should happen to be seated, not in the lobes, which are comparatively little affected by quinia, but near the base of the brain, in the centres of vision and hearing, and of the great organic functions, which it powerfully excites. Even without the positive existence of high vascular irritation or inflammation, a simple morbid tendency to these conditions might be goaded into dangerous action. This is not pure theory. One case at least is on record, in which fatal encephalitis, in an attack of miasmatic fever, was ascribed to the excessive use of quinia (Baldwin, *Am. Journ. of Med. Sci.*, N. S., xiii. 293); and, were unfavourable results as often noted as the favourable, it is not improbable that others might be adduced. It seems to me, therefore, a safer practice, in these fevers, to wait for a decided remission before prescribing quinia. The only exceptions I would make to this rule are cases, either originally pernicious, or becoming so in the course of the disease. In these, the danger of a fatal issue is imminent, and there is little risk of inducing active cerebral congestion or inflammation; as the tendencies are asthenic rather than otherwise, and the disposition much greater to nervous prostration and passive congestion, than to inflammatory action. In the pernicious remittent, therefore, or congestive fever of the South, quinia may be given freely after reaction has taken place, and before the occurrence of a distinct remission; and the main error to be guarded against is the exhibition of the remedy, in overwhelming doses, during the cold stage, or that of prostration, for fear of fatally aggravating the existing depression, by the indirect sedative influence of the quinia.

In *yellow fever*, also, quinia has been largely employed in this country, upon the same principle; that, namely, of suppressing the fever by its sedative influence. Given in doses of fifteen, twenty, or thirty grains, at an early stage of this complaint, it will undoubtedly often relieve and even remove the febrile phenomena; and, if the disease be moderate, and spontaneously curable, the patient will experience little subsequent inconvenience. But experience has shown that, though it may suppress the febrile symptoms, it is incapable of controlling those deeper derangements, and especially that depravation of the blood, in which the chief danger consists; and, in serious cases, the patient dies with prostration, hemorrhage, black vomit, etc., quite as certainly as though no quinia had been given. There is even reason for believing that the great secondary depression, resulting from the overwhelming doses sometimes used, may, when superadded to the debility of the second stage of the disease, produce a fatal result in cases, which, if otherwise treated, might end in recovery. There is, moreover, the risk of seriously aggravating any inflammatory condition or tendency which may exist in the brain, in the early stage, and of still further irritating the mucous membrane of the stomach, already perhaps the seat of high vascular irritation, if not of inflammation. The reader will perceive, therefore, that the sedative treatment by quinia is not that which I am disposed to recommend in yellow fever; though it is proper to state, that my conclusions have been deduced from *à priori* reasoning, and the recorded experience of others, and not from any experience of my own with this mode of treatment.

Typhoid or *enteric fever* is also among the diseases in which this method of treatment has been employed. Some have supposed that, like miasmatic fever, this affection could be promptly arrested, strangled as it were, by large doses of quinia. A knowledge of its pathology, one would imagine, should be sufficient to guard against this error; for that it is an error has, I think, been abundantly shown by experience. Sometimes, it is true, the disease seems to be mixed with remittent fever, having regular paroxysms, recurring at a particular hour every day, probably owing to the simultaneous action of the causes of the two complaints. In such cases, as I know from observation, quinia will check the paroxysms, and remove the regular remittent character; but the febrile affection will still march on, with its characteristic phenomena, to its regular termination. In France, sulphate of quinia in large doses has been used, not with a view to the prompt suppression of the disease, but in order to diminish the fever, lessen the danger, and lead to a speedier issue. M. Briquet, who employed it largely, states, as the result of his observation, that the pulse is moderated under its influence, the heat of skin diminished, and the cerebral symptoms very much alleviated; and on the whole, believes that this treatment will compare very favourably with any other which has been adopted. An apparently curious point, in his experience, is the effect of the medicine in diminishing stupor, quieting delirium, and otherwise favourably influencing the head affection. But the cerebral symptoms in this complaint are not those of active congestion or inflammation. They have probably a double origin, depending, in part, upon the depressing influence of the cause upon the brain, either immediately, or through the instrumentality of the diseased blood, and partly upon the irritating influence of the diseased bowels upon the cerebral centres. Now, quinia is calculated to obviate both these effects. By its excitant influence, it may counteract the operation of the depressing cause, and thus correct in some degree the characteristic stupor; while, in large doses, through an excess of the same influence on the organic centres, it renders them less impressible by the diseased glands of Peyer. We might, therefore, expect some favourable effects from large doses of quinia; but, though I have given the alkaloid often and freely in this complaint, I have never found from it any other advantage than a moderate supporting effect in the low states of the disease; and have often been compelled to omit it by an aggravation of the symptoms. I have certainly never seen it cure a case of the disease. Nor can the results obtained by M. Briquet be considered remarkably favourable, when judged of by his statistical report. Of forty-three cases of a serious character, including all that came under their notice, treated by himself and M. Blache, either in part or exclusively with sulphate of quinia, eight terminated fatally; and, of these eight, four, on post-mortem examination, exhibited undoubted signs of meningitis. (*Trait. Thérap. du Quinq.*, pp. 383 and 385.) Now, the proportion of deaths is here much greater than we habitually meet with in the Pennsylvania Hospital (see my work on the *Practice of Medicine*, 5th ed., i. 354), even if the serious cases only be taken into account; and the number of cases, four out of eight, in which signs of meningitis were discovered, is far beyond the usual proportion, under any ordinary treatment. The inference is fair, that the general result of the heroic treatment with sulphate of quinia is unfavourable, and that it causes death, either by directly inducing meningitis, or by aggravating a tendency to that affection already existing; which is exactly what might have been anticipated, from the views here inculcated of the action of quinia on the brain.*

In *typhus fever*, the abortive treatment by sulphate of quinia has been recommended strongly by Robert Dundas, of Liverpool; and has been tried with success by other British practitioners. Among those who report most strongly in its favour is Mr. J. O. Fletcher, who found it very effectual in cases of pure typhus, but not in those complicated with ulcerated bowels, in other words, not in typhoid fever. (*Lond. Med. Times and Gaz.*, vi. 422.) As a tonic, Peruvian bark has long been an established remedy in typhus fever; but the idea of employing it in large doses, with the view of speedily arresting the disease, is, so far as I know, of recent origin. Though I have used it much in the former capacity, I have no experience with it in large doses, given at the commencement of the fever, with a view to a direct febrifuge effect, and have no right, therefore, to speak decidedly on this point; but, if the humoral views of the pathology of this disease now prevailing are correct, that it depends, namely, on a poison which enters the circulation, and alters the state of the blood, depraving that fluid, and causing the generation within the system, and elimination from it, of a poisonous matter like itself, we know of no properties in quinia which should enable it to correct this condition of things; and, though by its secondary sedative influence it may suppress the febrile phenomena, it would be considered, with these views, as not likely to eradicate the disease. If it has the power of arresting that quasi zymotic action in the blood, which is supposed to characterize contagious diseases, it ought to be competent to the interruption of the course of smallpox, measles, and scarlatina; an influence which would scarcely be claimed for it by the most sanguine.

Petechial or *spotted fever*, or, as it is frequently called, *malignant cerebro-spinal meningitis*, is one of the low forms of fever in which quinia appears to act most favourably, if confidence can be placed in testimony. Given freely in the initial stage, it is said often very happily to dissipate the more alarming symptoms, and allow the disease to be conducted to a favourable issue. My own experience with it is confined to a single case, in which, in connection with morphia, it appeared to act most happily.

---

* A case has fallen under my notice, strongly illustrative of the dangerous effects which may arise from very large quantities of sulphate of quinia in this fever. I was called in consultation to a case of fever, which the attending physician considered, and was treating as an ordinary bilious remittent. I thought I had convinced him that it was enteric or typhoid fever, and we separated after agreeing to a course of treatment consonant with this view. It appeared, however, that he was not really convinced; and, determined apparently to prove me in the wrong, he directed between thirty and forty grains of the sulphate of quinia to be administered during the day. There had previously been no alarming symptoms in the case; but, on the repetition of my visit next day, I found the patient in violent convulsions, and within twenty-four hours he died comatose. (*Note to the second edition.*)

In *puerperal fever*, sulphate of quinia, in large doses, is asserted to have been employed with extraordinary success; and, in epidemics of that affection, it is believed to have been used advantageously as a preventive. M. Beau, of Paris, is among those who strenuously advocate the use of the medicine in this frightful disease. It is given in the quantity of from fifteen to thirty grains in the day, or sufficient to induce the decided effects of quinia on the system. (*Ann. de Thérap.*, 1858, p. 178.)

Acute Rheumatism. Peruvian bark was long since employed as a remedy in acute rheumatism in Great Britain; but the practice had been abandoned, and only came again into general notice after the publication of the results obtained by M. Briquet, and other French physicians, about the year 1842, with large doses of sulphate of quinia in that disease. There can be no doubt that, under the use of this salt, in the quantity of half a drachm, more or less, given daily in divided doses, cases of acute rheumatism have often yielded, and entered into convalescence, without any serious inconvenience, at a much earlier period than they ordinarily do if left alone. Very soon after the system has come under the full influence of the remedy, the pains and swelling abate, sleeplessness is relieved, and the pulse is reduced in frequency and force; and the patient, in most instances, when the disease is uncomplicated with inflammation of the internal organs, as of the heart, will become convalescent in about ten or twelve days from the commencement of treatment. Sometimes, however, as under every other treatment, the complaint is much more prolonged, and, when complicated with pericardial or endocardial inflammation, extends to an average period of sixteen days or more; though it is asserted that these inflammations, especially if encountered by general or local bleeding, afford no contraindication to the use of quinia. According to Briquet, the cases least benefited by the sulphate of quinia are those of a plethoric character, in which the inflammatory fever is intense, and the pulse full, hard, and frequent; while those in which it proves most advantageous are lymphatic subjects, or those weakened by previous disease, or excessive depletion, with pale skin, and a very frequent but not well-developed pulse. This is exactly what might have been expected, from the views of the action of sulphate of quinia here advocated, and quite contradictory to the notion of its direct sedative power. The medicine suppresses the morbid phenomena by an over-excitement, and consequent diminution of the excitability of the nervous centres through which the phenomena are induced, and not by a direct sedative influence on those centres, or on the circulation. But in this very circumstance exists the danger of the practice. Should there happen to exist already in these centres, as now and then happens in acute rheumatism, a vascular irritation or positive inflammation, or a strong tendency to it, then the fear is that quinia may aggravate this condition, and lead to fatal inflammation within the encephalon. This is asserted to have happened in several cases, in consequence of which, the practice has not been generally adopted by the profession; and I am not inclined to recommend it. The only circumstances under which I should think it advisable to administer quinia, in acute rheumatism, not complicated with miasmatic fever, are those of general debility, and especially as indicated by *profuse sweats, occurring during sleep, and not at other times.* As before stated, I have for a long time been in the habit of employing, and of recommending, in my lectures, the use of quinia freely in this condition, and have almost always found it promptly effectual in relieving the symptoms, and generally curative.

In *chronic rheumatism*, the remedy is less efficient than in the acute; but, when carried to the amount of thirty or forty grains daily, it has sometimes proved effectual, especially in cases in which the inflammation has been disposed to change its seat, and thus approach the acute in character.

Gout is affected by quinia in a manner very similar to its mode of action in rheumatism. In the acute form, large doses of it will sometimes suppress the local inflammation; but the disease is not subdued, and there is always danger of its appearance in some other of its numerous shapes. The practice, therefore, is almost never resorted to. But, in debilitated states of the disease, the medicine may be used advantageously, as a tonic, and, in the nervous forms, is not unfrequently useful as an antiperiodic or superseding remedy.

In the *phlegmasiæ*, or local inflammations attended with symptomatic fever, quinia has been thought by some to have a curative effect, in large doses, through its sedative influence. But, for the cure of inflammation, something more is necessary than to reduce the force and frequency of the pulse. Otherwise digitalis would be among the most efficient remedies in that affection, over which, indeed, it has been found to have little influence. An important indication, in the phlegmasiæ, is to reduce or alter the quality of the blood, as well as to lessen the quantity, or the force with which it enters the inflamed part. Now quinia has no effect of this kind. As already stated, it has a tendency rather to increase than to diminish the proportion of fibrin in the blood, the augmentation of which is one of the characteristics of severe inflammation. It is true that, except in the phlegmasiæ of the brain, and the alimentary mucous membrane, and probably the urinary passages, it has little if any direct effect in increasing inflammation; and the existence, therefore, of this condition does not positively forbid the use of quinia when decidedly indicated on other grounds; but, in simple inflammation in its active stage, there is no sufficient ground for its use; and, in the large quantities which would be required to suppress the febrile phenomena, it might in various ways do harm.

But there are states of inflammation in which it is highly useful. As before mentioned, it may be employed, often with the greatest benefit, in miasmatic intermittent and remittent fever complicated with this condition; acting as an antiperiodic in reference to the general disease, and relieving if not curing the local, by removing the injurious influence of the paroxysmal excitement upon it. Moreover, when inflammation is attended with a low, asthenic, or typhoid state of system, this medicine is highly useful as a tonic, aiding in the support of the system until the inflammation has run its course. Upon the same principle, it is useful in the suppurative or gangrenous state of inflammation; and, in these cases, has the additional advantage that, by its tonic powers, it assists in the repair of the local injuries inflicted by the disease, which might not be carried on to completion without this or equivalent aid.

5. LOCAL USE. Peruvian bark is slightly irritant to the parts with which it is brought into contact, and sulphate of quinia more so. Hence, the powdered bark was formerly sprinkled over indolent, flabby, and sloughing ulcers; and the decoction was employed as a gargle in gangrenous ulceration of the fauces. The remedy was supposed to be peculiarly useful in mortifying parts, from the fact that bark has some influence in retarding the putrefaction of animal matters; but it is now well understood that the antiseptic property, though it may tend to prevent the decomposition of parts already dead, and, therefore, to correct fetor in sloughing ulcers, has no influence whatever, as such, on the process of mortification; and consequently, if Peruvian bark is useful in such cases, it is by supporting the vital actions through its tonic, and not through its antiseptic powers.

The effect of the medicine in giving tone to the stomach may be considered as, in some degree, the direct result of its local application to the gastric mucous membrane; and, in the same way, it may do good in ulcerative conditions of the bowels, in which a local stimulation is desirable; as in some cases of chronic diarrhœa and dysentery, and the advanced stages of enteric or typhoid fever.

As quinia passes unchanged through the kidneys, and is thus brought into immediate contact with the urinary passages, it must exert upon these its ordinary local stimulation, and may thus prove useful in certain cases of chronic inflammation and ulceration of the pelvis of the kidneys, the ureter, and the bladder, and in retention and incontinence of urine dependent on debility of the bladder or its sphincter.

Sulphate of quinia may be used locally for the same purposes as the bark, but, in this case, should be much diluted with some unirritating material.

7. *Preparations, and Modes of Administration.*

Powdered Bark. The powder might be the most efficacious form for administration, could it always be taken in sufficient quantities, and without irritation of the stomach. But its taste is so revolting to most patients, and it is so apt to occasion nausea, if not vomiting, that it is often almost impossible to employ it in quantities sufficiently large to produce the effects required. The taste may, it is true, to a considerable extent, be concealed or corrected by appropriate management; but still the medicine will often offend the stomach by its directly nauseating properties, and, if in no other way, by its great bulk alone. So much do these disadvantages impair its efficiency, that formerly, when the bark in substance was mainly relied on in the treatment of periodical fevers, it was not unfrequently difficult to break them, and sometimes almost impossible; and, at all events, the treatment was much more prolonged than at present. Trousseau, indeed, considers the powder preferable to the sulphate of quinia, being, as he thinks, less apt to irritate the stomach, and, if properly administered, less offensive to the taste; but it seems to me that this eminent therapeutist must either never have taken the medicine himself, or be misled by personal idiosyncrasy; for certainly the general experience is very much opposed to him. Nevertheless, there may be instances in which, from constitutional peculiarity, sulphate of quinia may fail of its usual effect; or may be accidentally unattainable in due time; and, in either case, recourse may be had to the bark in substance

The variety selected for internal use should be one of those richest in alkaloids; as it is important that as much strength should be concentrated in as small a bulk as possible. Hence, either the Calisaya bark, or the best red bark, or one of the finest varieties of the Carthagena barks, as the soft or hard Pitaya, should be preferred. (See *U. S. Dispensatory,* 12th ed.) Any bark containing two per cent. of alkaloids may be ranked among the efficient varieties.

The *dose* of powdered bark, as an antiperiodic, is about a drachm, repeated every hour or two, or at such intervals that from one to two ounces may be taken between the paroxysms. In reference merely to the tonic effect, from ten to thirty grains are sufficient to commence with.

The powder should be given diffused in water, or other liquid vehicle. It is not the best plan to mix each dose extemporaneously when administered; for the dry powder is not readily diffused in water, and the attempt often results in producing an offensive dose, sufficient, by its very appearance, to produce nausea in one who may have previously taken the medicine. A better method is to introduce a certain quantity of the bark and of the vehicle, say two ounces of the former and two pints of the latter, into a bottle, allow them to stand until the powder has become wet throughout, and then, when the dose is to be taken, to shake them well, and pour out a wineglassful of the turbid liquid. The addition of a fluidrachm of aromatic sulphuric acid, for each ounce of the bark, will correct in some degree the nauseous taste, and increase its efficiency by rendering soluble the compounds of the alkaloids with the colouring matter. Wine was formerly much employed as the vehicle; but it would be too stimulating for ordinary use. Trousseau strongly recommends hot sweetened coffee, which he says completely corrects the taste. When the bark purges, it should be conjoined with opium, when it constipates, with a little rhubarb.

Infusions. The U. S. Pharmacopœia recognizes two infusions, one prepared from the yellow bark (Infusum Cinchonæ Flavæ), the other from the red (Infusum Cinchonæ Rubræ). These are not simple infusions, like those of the preceding Pharmacopœia; but are made in accordance with the old formula for compound infusion (Infusum Cinchonæ Compositum, *U. S.* 1850), by the addition of a fluidrachm of aromatic sulphuric acid to a troyounce of the powdered bark. The acid is first mixed with a pint of water, and this mixture is then used in percolation, enough water being poured on, at the end of the process, to make the infusion measure a pint. These are elegant preparations, and afford one of the most efficient methods of administering cinchona. All the virtues of the bark are extracted, and probably in a condition of greater activity than in the powder itself; as, by means of the acid, the whole of the active matter is now dissolved, and therefore readily absorbable. These infusions may be used for all the purposes of the medicine. The dose is two fluidounces, to be repeated three or four times a day, as a tonic, in chronic debility; every two hours in low fevers; and in such a manner as to amount to one or two pints between the paroxysms, in periodical diseases. For use in the typhous state of fever, they may be prepared with wine as the menstruum instead of water.

The officinal infusions above described are expected to be made in the shop. For a simple extemporaneous infusion, the old method of macerating an ounce of the coarsely powdered or bruised bark in a pint of boiling water, may be resorted to, in accordance with the present British plan. The simple infusion may also be made by treating the coarsely powdered bark by percolation with cold water, which forms a more elegant, and probably stronger preparation. The hot infusion is somewhat turbid; that made with cold water, perfectly clear. In neither is the bark nearly exhausted; for water will not dissolve that portion of the alkaloids which is combined with the cinchonic red. Pale bark has sometimes been preferred, in consequence of its less disagreeable taste; but just in the same proportion is it less efficient. The preparation is at best feeble, and is used only as a tonic. The dose is two fluidounces, three or four times a day in chronic cases, more frequently in the acute.

Decoctions. The U. S. Pharmacopœia directs separately the decoction of the yellow bark (DECOCTUM CINCHONÆ FLAVÆ), and of the red (DECOCTUM CINCHONÆ RUBRÆ). These are made by boiling an ounce of the bruised bark in a pint of water, for fifteen minutes, straining while hot, and adding enough water through the strainer to make the decoction measure a pint. At the end of the boiling, and before the liquid begins to cool, two drachms of orange-peel may be advantageously added. This mode of preparation was formerly much resorted to, when it was deemed desirable to obtain the virtues of the bark speedily in a liquid form. Its disadvantages are that it does not completely exhaust the bark, and that on cooling the decoction becomes turbid, and deposits a precipitate. The turbidness is owing, partly, to the formation of tannate of starch, which, though dissolved by the water when hot, is insoluble in cold water, and therefore subsides on cooling; and, partly, to the deposition of a compound of the alkaloids with the colouring matter, previously existing in the bark, and partially taken up by the water at the boiling temperature. Hence the necessity of straining while hot, so that a portion of the active matter extracted in the decoction may not be lost. Of course, the precipitated matter should be again mixed with the water by stirring, when the decoction is administered. It would be a great improvement in this preparation to add a little sulphuric, muriatic, or citric acid to the menstruum before boiling. The bark would then be exhausted, and the active matter retained in solution upon the cooling of the decoction. Wine may be advantageously substituted for water in the preparation, when there is an indication at once for alcoholic stimulation and the effects of the bark, as often happens in low fevers. Indeed, the decoction of bark in wine was formerly much used in the prostrate state of fevers of a typhoid character, and with great advantage. The dose of the decoction is two fluidounces, to be repeated in the same manner as the infusion.

Tinctures. Two tinctures are directed by our officinal code, one simple, and the other compound.

The simple *Tincture* (TINCTURA CINCHONÆ, *U. S.*) is ordered to be made with the officinal yellow or Calisaya bark. This is in order to insure efficiency; for this variety of bark is more uniformly strong with alkaloids than most others; but any variety ascertained to be of equal strength may be employed. The bark is probably completely exhausted when the process is properly conducted, especially if percolation is employed. The tincture would, therefore, be very efficient, were it not that the proportion of alcohol to the active matter dissolved by it is so great as to give undue prominence to its effects, and thus often to render impossible the administration of a sufficient quantity to obtain the desired influence of the bark. Though the tincture is strong, yet a fluidounce of it contains the virtues of only a drachm and a half of the bark. In patients of intemperate habits, or in very prostrate states of fever, this would be an advantage; and, in such cases, the tincture may be used with propriety. But it is more prescribed as an addition to the infusion or decoction, or in connection with sulphate of quinia, in cases requiring alcoholic stimulation, than by itself. It may be thus employed with propriety in cases of pernicious fever, attended with great prostration, as well as in fevers of the typhous character. In consequence of the resin it contains, it becomes turbid on dilution with water. The dose is from one to four fluidrachms.

The *Compound Tincture* (TINCTURA CINCHONÆ COMPOSITA, *U. S.*) is the preparation commonly known as *Huxham's tincture*. It differs from the preceding in containing serpentaria and orange-peel with colouring matter, and in being prepared with red instead of yellow bark. It is made with a much smaller proportion of bark than the simple tincture, and is less suitable as an antiperiodic, or in cases requiring a strong impression from the medicine. It is, however, an elegant stomachic cordial, useful in cases of feeble digestion and general debility. The dose is a fluidrachm.

Extracts. An *Extract* (EXTRACTUM CINCHONÆ FLAVÆ, *U. S.*) is prepared, according to our officinal code, from the yellow bark; but the preparation would be equally effectual made from the red, if carefully selected. In its preparation, the bark is exhausted first by alcohol and afterwards by water; the tincture and infusion are separately evaporated to the consistence of honey; and the two are then mixed, and the evaporation completed. It thus appears that the bark is deprived of all its active matter; and the extract cannot but be very efficient, if due care is exercised in selecting the bark, and in conducting the evaporation. But, as a large proportion of the matter dissolved by the menstrua is inert, as the gum, resin, and cinchonic red, the preparation is much less efficient than the separated alkaloids, and is now little used. As found in the shops, it is not unfrequently very feeble, from the want of attention to the points above referred to. The dose is from ten to thirty grains.

The *Fluid Extract* (EXTRACTUM CINCHONÆ FLUIDUM, *U. S*) is a new officinal of our Pharmacopœia. It is a highly concentrated tincture, from which a considerable proportion of the alcohol has been driven off, and its place as a preservative agent supplied by sugar. It is much preferable to the *Extractum Cinchonæ Flavæ Liquidum* of the British Pharmacopœia, which is simply an inspissated infusion, to which spirit is added, partly for its preservation, and partly for the solution of matter deposited during the latter part of the process. This latter preparation is no doubt efficacious, but is liable to the same objection as all others in which water alone is the menstruum; namely, that the virtues of the bark are not wholly extracted. The dose of the U. S. fluid extract, representing a drachm of the bark, is two fluidrachms. For antiperiodic effect, at least two fluidounces should be given between the paroxysms.

SULPHATE OF QUINIA.—QUINIÆ SULPHAS. *U. S.*, *Br.*

Preparation. This is, beyond all comparison, the most important and most extensively used of the preparations of bark, and may be considered as a sufficient representative of its virtues, on all ordinary occasions. For the details of its preparation, the reader is referred to the U. S. Dispensatory. For our purposes here, it is sufficient to state that officinal yellow or Calisaya bark, which is usually selected, is exhausted by boiling it with water acidulated with muriatic or sulphuric acid; that, from the decoction thus obtained, the quinia and other alkaloids are precipitated, together with impurities, by means of lime; that the precipitate is treated with alcohol, which dissolves the alkaloids; that the alcoholic solution is then evaporated; and, finally, that from the residue, consisting mainly of quinia, the sulphate is obtained by treating it with boiling water and sulphuric acid, purifying with animal charcoal, and crystallizing.

Sensible and Chemical Properties. Sulphate of quinia is in minute, white, silky, flexible, needle-shaped crystals, in tufts or interlaced, inodorous, intensely bitter, fusible at 240° F., soluble in 740 parts of cold water, 30 of boiling water, and 60 of alcohol, and very slightly soluble in ether. It is, however, very readily dissolved by water acidulated with almost any one of the sour acids. It is also soluble, to a considerable extent, in glycerin, which, if slightly heated, is said to take up more than one-twelfth of its weight. (*Lancet*, Am. ed., ii. 262.) Its aqueous solution exhibits a beautiful bluish colour or opalescence on its surface. Two views are taken of its composition; one, that it is a *neutral sulphate*, containing one eq. of acid and one of base; the other, that it is a *disulphate*, containing one eq. of acid, and two eqs. of base. The former opinion, which was first entertained, subsequently gave way to the latter; but some chemists are disposed to return to it, and the author has always considered it as most probably correct; so that the ordinary designation of the salt should, in his view, be retained. If it be considered a neutral salt, its exact composition will be expressed by the formula; one eq. of sulphuric acid 40, one of quinia 324, and eight eqs. of water 72 = 436. It loses part of its water of crystallization by exposure, or by heat, but always retains about 4 per cent. or two eqs. of water, from which it cannot be separated without decomposition.

Bisulphate of Quinia. By an additional equivalent of sulphuric acid, the sulphate is converted into the *bisulphate*, by some considered as the neutral salt. This is much more soluble in water than the ordinary sulphate, requiring only 11 parts of cold water for solution, and is freely dissolved by alcohol. It is formed extemporaneously in solution, with the utmost facility, by gradually dropping a little diluted sulphuric acid into a mixture of the ordinary sulphate with water, until the latter is dissolved.

Incompatibles. The substances which yield precipitates with solutions of sulphate of quinia, and should, therefore, not be administered, as a general rule, along with it, are the alkalies and their carbonates, the alkaline earths, all astringent solutions containing tannic acid, and the soluble salts of lead and baryta. The soluble salts of oxalic, tartaric, and gallic acids also occasion more or less precipitation with solution of sulphate of quinia, without excess of acid; and the same has been ascertained to be the case, by Mr. Maisch, with the soluble acetates (*Am. Journ. of Pharm.*, xxvii. 97); but the precipitates may be redissolved by the addition of an acid.

Adulteration. Sulphate of quinia is liable to adulteration; but this can generally be easily detected by referring to its peculiar solubilities. The presence of mineral substances, not easily volatilized by heat, will be evinced by a residue left behind when a small portion of the salt is put upon red-hot iron. (See *U. S. Dispensatory*, 11th ed., p. 1239.)

Effects. The properties of sulphate of quinia as a therapeutic agent have already been sufficiently considered. In reference to its antiperiodic and secondary sedative effects, it has all the power of bark, and more indeed than can always be exerted by the crude medicine. As a mere tonic, it is possible that the compound infusion, or some other preparation in which all the active principles of bark are contained, or the bark itself in substance, may be more efficacious; but I do not think that the fact has been rigidly demonstrated. The peculiar advantages of the salt are its convenience of administration, its general acceptability to the stomach, the rapidity with which it is absorbed, the facility of ascertaining its purity and genuineness, and the opportunity which it affords, by the smallness of its dose, of obtaining the peculiar effects of bark in a degree greater than can be obtained, as a general rule, from the bark itself.

Administration. Sulphate of quinia may be administered in substance or solution. In my own experience, I have been able to discover little difference, in therapeutic results, between these two modes of exhibition; though it is asserted by M. Briquet, as an inference from his experiments, that the solution formed by the addition of a little sulphuric acid, and containing, therefore, the bisulphate, will produce the antiperiodic effect more quickly, and in considerably smaller doses, than the ordinary sulphate given in substance. There can be no doubt that the salt in solution will be more readily absorbed into the circulation than the undissolved salt; but the ordinary sulphate is so readily dissolved by water slightly acidulated with almost any acid, that the instances must be very few, in which there is not sufficient acid in the primæ viæ for this purpose. It is, I presume, very seldom that the sulphate of quinia passes undissolved through the stomach, unless secured against the action of the gastric acids by a vicious mode of exhibition. The salt in substance is usually given in pill, or suspended in water; very rarely in the form of powder.

The officinal *Pills of Sulphate of Quinia* (PILULÆ QUINIÆ SULPHATIS, *U. S.*) are made by the addition of gum and honey, and contain, each, a grain of the salt. They answer very well when made extemporaneously; but, if kept very long, there is danger that they may become so hard as to afford a mechanical impediment to solution, and consequently to pass through the stomach unchanged. Nevertheless, I have used very old officinal pills, with prompt and powerful effect, as an antiperiodic. A method of preparing them suggested by Mr. Edward Parrish seems to offer some advantages. This plan is simply to triturate together 20 grains of the salt and 15 drops of aromatic sulphuric acid, until a pilular mass is formed. The pills are thus obtained of smaller bulk and more soluble; and a pill of five grains is not inconveniently large.

The salt, *if finely powdered*, may be suspended in water by simple agitation; but the intervention of syrup or mucilage is preferable. M. Trousseau gives it stirred up in hot and sweetened coffee, which seems to correct its taste. The probable conversion of the salt into an insoluble tannate may be urged against this method of exhibition; and the same objection holds against the plan of mixing the salt with tannic acid, as recommended by the late Dr. Thomas, of Baltimore; but when it is very important, as in some infantile cases, to destroy the taste, either method may be employed; as, though the tannate may act less rapidly, and require a larger quantity for a given effect, than the sulphate, yet it is in fact dissolved in the stomach whenever acid is present, and experience has proved its efficiency. Dr. W. H. Edwards, of Virginia, has found that, by enveloping sulphate of quinia in a spoonful of thick mucilage of slippery elm, without allowing it to touch the sides of the spoon, it may be taken without the taste being in the least degree observed. (*Stethoscope*, iv. 338.)

The *solution of sulphate of quinia*, which, when its bitter taste is not objectionable, is the best form for administration, may be made by adding twelve minims of aromatic sulphuric acid to eight grains of the salt in a fluidounce of water; in other words, a minim and a half for each grain.

Twelve grains of the sulphate may be considered as equivalent to one ounce of good bark.

The *doses* proper under different circumstances have been already stated. It may be repeated that, as a tonic, the dose of sulphate of quinia is a grain, to be repeated in chronic cases three or four times a day, in acute cases every two or three hours; as an antiperiodic, from twelve to twenty-four grains between the paroxysms, in ordinary periodical diseases, which may be increased, in pernicious fever, and very obstinate neuralgia, to from thirty to sixty grains, these amounts being, as a general rule, divided into doses of from one to five grains at equal intervals; and, in reference to the secondary sedative effects, not less than fifteen or twenty grains daily, which must sometimes be considerably increased.

A *Tincture of sulphate of quinia* is directed in the Br. Pharmacopœia under the name of TINCTURA QUINIÆ COMPOSITA, being made by dissolving sulphate of quinia in tincture of orange-peel. A fluidrachm of it contains a grain of sulphate of quinia. It is a convenient preparation in some cases where the conjoint use of quinia and alcohol is indicated.

If the stomach will not retain the salt, it may be given by the rectum; from six to twelve grains, in ordinary cases, either dissolved by means of a little citric acid, or suspended in two fluidounces of mucilage or solution of starch, and mixed with from twenty to forty drops of laudanum, being injected into the rectum every six hours. In urgent cases, this quantity may be very greatly increased.

The *endermic method* is sometimes resorted to; but the application of sulphate of quinia, undiluted, upon a surface deprived of the cuticle, is apt to produce superficial sloughs; and its employment in this way should be restricted to cases of emergency. It should also be mixed, before application, with some unirritating substance, as powdered gum or arrow-root. The epigastrium, and insides of the thighs and arms, are proper positions for its endermic use.

The *hypodermic method* has come into considerable use, and in certain cases may be very advantageously employed. Indeed, *sulphate of quinia* is peculiarly adapted for subcutaneous injection; being readily absorbed by the areolar tissue, and producing its effects in quantities not too large for this mode of application; but it is liable to the objection, that it is not readily dissolved, while the success of the plan depends upon the perfect fluidity of the substance injected. This objection, however, may be obviated by means which will be mentioned directly. The characteristic effects of quinia on the system are more rapidly and more certainly obtained in this than in the ordinary modes of administration; and, in the same dose, the medicine will produce greater effects. Besides, the patient escapes all those disturbances of the stomach which occasionally follow its use when swallowed. The hypodermic method, however, is liable to some slight inconveniences, which will prevent its general substitution for the usual methods; but there are circumstances which decidedly indicate, and some which imperatively call for it. 1. Whenever there is an obvious indication for the use of quinia, and, after a fair trial by the mouth and rectum, it fails to produce the desired effect, there is clearly a call for its subcutaneous use. 2. A still stronger demand is made for it in cases where, from an irritable state of the stomach or bowels, from an inability or refusal to swallow it, as in some low cases of disease, and with maniacs or infants, or from idiosyncrasies of the patient, it is either very difficult or altogether inexpedient to give it by the mouth. 3. There are, besides, affections so exceedingly painful, and others so imminently dangerous to life, that it is imperatively necessary to have recourse to the most prompt and most effectual means of relief and safety. This condition of things is presented in certain cases of neuralgia, and in all cases of the pernicious form of miasmatic fever, especially in the latter, when, as often happens, the stomach is excessively irritable.

For the method of effecting subcutaneous injection, and the instruments employed, the reader is referred to page 81 of this volume. To obtain the salt of quinia in the liquid form, it is necessary either to use the bisulphate, which is much more soluble than the sulphate, or, what is still better, to add just as much of the diluted sulphuric acid, or of one of the vegetable acids, as the acetic, citric, or tartaric, as may be necessary for the solution of the sulphate in the admissible quantity of water, which for one dose should not exceed twenty or thirty minims. It is important not to use more acid for the purpose than is necessary to solution, because in excess it acts as an irritant to the tissues. The dose of the sulphate of quinia may be from one-third to one-half that given by the mouth for the same purpose. For antiperiodic effect, four or five grains may be given two or three hours before the expected paroxysm; and if postponed still later, even to within an hour or three-quarters of the chill, some effect may be expected. The solution may be injected in either of the extremities, or in the trunk along the spine. On the whole the arm is the most convenient.

Friction upon the surface with sulphate of quinia, in the form of liniment or ointment, has also been recommended. For this purpose, a drachm of the sulphate, finely powdered, may be incorporated with two drachms of lard; but it would be better that the salt should be preliminarily dissolved, as it is more readily absorbed in this state. The following formula is essentially that of M. Boudin. Dissolve a drachm of sulphate of quinia in the least possible quantity of alcohol, with the aid of a little aromatic sulphuric acid, and incorporate the solution with four drachms of melted lard. The salt being soluble in oleic acid, or pure lard oil, M. Lhermite recommends to dissolve one part of it in ten parts of the oil, with the aid of a gentle heat; the oil being previously scented with an agreeable volatile oil, as that of bergamot, for example. Either of these preparations may be rubbed, *ad libitum*, upon the inside of the upper or lower extremities, or in the axilla.

The idea of bringing young infants under the influence of quinia through the milk of the mother, by administering the medicine to the latter, has suggested itself to practitioners; but the alkaloid is probably not thrown off with this secretion; at least numerous attempts to detect it in the milk of women under its influence have failed. This plan, therefore, should never be relied on, and is the less necessary, as it is very easy to give the remedy to the child directly, by resorting to some expedient for covering the taste.

Other Salts of Quinia. Numerous other salts of quinia have been recommended, on various grounds, as substitutes for the sulphate. The *acetate*, *antimoniate*, *arsenite*, and *arseniate*, *citrate*, *ferrocyanate*, *lactate*, *muriate*, *tannate*, and *valerianate*, have severally had their peculiar advocates; but the insolubility of most of them is one objection; and, though this may be overcome by the acid of the stomach, or the addition of an acid previously to administration, yet there exists another objection; that, namely, as they act through the quinia they contain, and all of them have a less proportion of this than the sulphate, in consequence of the higher combining number of their acid, they must be proportionably less efficient, even when dissolved. Besides, experience has failed to establish any superiority of any one of them over the sulphate, except as regards the taste; and, in relation to the salts with arsenious and arsenic acids, they cannot be given in quantities sufficient to obtain the influence of quinia over the system, without incurring the risk of danger from the arsenical ingredient. Of the above named salts, the *valerianate of quinia* (QUINIÆ VALERIANAS, *U. S.*) is officinal; and directions for its preparation are given in the U. S. Pharmacopœia. It is soluble in 110 parts of cold and 40 of boiling water, in 6 parts of cold and an equal weight of boiling alcohol. It has a strong disagreeable odour of valerianic acid. It is peculiarly applicable to debility combined with nervous disorder, and may be found useful in some cases of neuralgia, and hemicrania. The dose is one or two grains, three or four times a day.

CRUDE QUINIA. In the process for preparing sulphate of quinia, after the evaporation of the alcoholic solution, and before the addition of sulphuric acid, a semiliquid substance is obtained, which, being dried, constitutes the substance here referred to, under the name of crude quinia. It has a resinous aspect, and a brownish-fawn colour more or less deep, is softened by heat so as easily to be formed into pills, is much less bitter than the sulphate, and consists, as procured from Calisaya bark, mainly of quinia, which is mixed with whatever other alkaloids may exist in the bark, and more or less colouring and perhaps resinous matter. It has all the effects of sulphate of quinia, and may be employed for the same purposes. Though but very slightly soluble in water, it is readily dissolved by the addition of an acid, and is consequently soluble in the gastric liquor. From its comparative want of taste, it is applicable to infantile cases. The only objection to it is that, from its want of a precisely definite composition, it cannot be so readily guarded against adulteration. It may be given in the same doses as sulphate of quinia, either in pill, or suspended in water. Dissolved by means of an acid, it acquires the bitter taste of the sulphate.

QUINOIDIN.—AMORPHOUS QUINIA—QUINICIA and CINCHONICIA. After the crystallization of all the sulphate of quinia that can be obtained in that form, in the process for preparing the salt, there is left behind a mother liquor, by the evaporation of which a dark amorphous substance is obtained, which was formerly recognized by our Pharmacopœia under the name of *impure sulphate of quinia.* This had been used, before being thus officinally recognized, by the late Dr. Samuel Emlen, of Philadelphia, and by the author, with all the effects of the pure sulphate in the case of intermittents, though requiring to be given in about double the dose. It was supposed to consist of sulphate of quinia with a little sulphate of cinchonia, and colouring impurities. From the want of precise characters by which it could be recognized, it has been abandoned in the recent revisions of the Pharmacopœia.

Sertürner supposed that, in this residuary matter, he had found a new alkaloid, which was named *quinoidin* from its resemblance to quinia. According to Liebig this new alkaloid has the same composition as quinia, from which it differs only in being uncrystallizable, and imparting this same property to its salts. He therefore named it *amorphous quinia.* Pasteur ascertained that what was called quinoidin by Sertürner, and amorphous quinia by Liebig, consists usually of two alkaloids, one called by him *quinicia,* because derived from quinia, the other *cinchonicia,* from the same relation to cinchonia. They are probably mainly the result of the process for extracting the alkaloids; the heat employed having the effect of modifying the state of quinia and cinchonia, as the same agency converts crystallizable into uncrystallizable sugar.

The substance called *quinoidin* in commerce, containing the amorphous quinia of Liebig, is obtained by precipitating the mother liquor of sulphate of quinia above referred to, by means of an alkaline carbonate, which decomposes the sulphates contained in it, and throws down the uncombined alkaloids. By repeated solution and precipitation, the alkaline matter may be obtained quite pure, and, in this state, consists of the two alkaloids quinicia and cinchonicia, together with whatever other organic alkali may have existed in the bark, as cinchonia, and possibly sometimes quinia, quinidia, and cinchonidia. When pure, it is an excellent preparation, and may be employed, in all cases, as a substitute for sulphate of quinia, in about the same dose.

SULPHATE OF CINCHONIA. — CINCHONIÆ SULPHAS. *U. S.* This was first recognized as officinal in the present U. S. Pharmacopœia. It may be made by directly combining its ingredients, or by crystallization from the mother waters of sulphate of quinia, after this salt has been wholly separated from them. It is in short, oblique, shining, prismatic crystals, with dihedral summits, which melt at 212° F., are soluble in 54 parts of cold, and a much smaller proportion of boiling water, are readily dissolved by alcohol, and scarcely soluble in ether, and have a very bitter taste. The salt is either a *sulphate* or *disulphate*, according to the opinion which may be adopted as to the equivalent of cinchonia; and, like the sulphate of quinia, may be converted into a more soluble salt by combination with an additional equivalent of acid It has been abundantly proved to have the therapeutic virtues of sulphate of quinia, though somewhat feebler. A general result of observation has been that it is less apt than sulphate of quinia to occasion buzzing in the ears, deafness, and disturbance of vision, at least in the same dose; though. according to Bouchardat, it produces, even in smaller doses and more certainly than that salt, a peculiar headache, rather severe, which is seated specially in the anterior part of the head, and is attended with a remarkable feeling of compression. (*Ann. de Thérap.*, 1857, p. 126.) To obtain the same effects from it, the dose should be about one-third, or at least one-quarter, greater than that of the salt of quinia.

SULPHATE OF CINCHONIDIA.—CINCHONIDIÆ SULPHAS. This is the salt which a few years since first came into notice under the name of *sulphate of quinidia*, which name is commercially still applied to it. The fact is that, as sold, it is usually complex, consisting of the two sulphates of cinchonidia and quinidia, though with a great predominance of the former. It is obtained for use from the barks which most abound in cinchonidia, by the same process as that employed in the preparation of sulphate of quinia from Calisaya bark. Like the analogous salt of quinia, this is considered by some as a neutral, by others as a subsalt, and by the latter would be called a *disulphate*. It is in long, silky, acicular crystals, soluble in 130 parts of cold and 16 of boiling water, readily soluble in alcohol, but nearly insoluble in ether; and by these properties may be distinguished from the corresponding salt of quinia. It has the same effects as the sulphates of quinia and cinchonia, and may be employed in the same doses as the latter salt. That it is little if at all inferior, in the treatment of intermittent fever, has been abundantly proved by the trials made with it by Dr. J. S. Dorsey Cullen, in the Almshouse Hospital of Philadelphia (*Am. Journ. of Med. Sci.*, N. S., xxix. 81); and those of Dr. Geo. L. Upshur, surgeon to the U. S. Marine Hospital at Norfolk (*Med. Examiner*, N. S., x. 740). From fifteen to thirty grains were employed between the paroxysms.

I am not aware that the proper *sulphate of quinidia* is used as a distinct preparation. It is contained occasionally in the sulphates of the other cinchona alkaloids, and is probably identical in therapeutic influence with sulphate of quinia, or so nearly so as to render its presence, in small proportions, of no practical importance.

Peruvian bark owes its special virtues to the peculiarity of its active tonic principles. Besides nectandra or bebeeru bark, recently admitted into the officinal catalogues, there are several substances of minor importance, supposed to possess peculiar virtues, which, if the claim be admitted, must rank in the same category. Among these are the dogwood and willow barks. It is true that these have a portion of tannic acid associated with the bitter principle; but it is not to this that the remedial effects ascribed to them, and to which they mainly owe what reputation they possess, can be attributed, any more than the characteristic remedial properties of Peruvian bark can be attributed to the tannic acid which it also contains. If they have special virtues, these reside, in all probability, in their bitter principle; and the medicines, therefore, may be appropriately considered here.

1. NECTANDRA. *U. S.*, *Br.*—Syn. *Bebeeru Bark.*

This bark, which is the product of *Nectandra Rodiœi*, or bebeeru-tree, a lofty tree inhabiting Guiana and neighbouring parts of South America, was introduced into the Pharmacopœias mainly as the source of a peculiar alkaloid, having virtues analogous to those of the cinchona alkaloids. The bark is in large flat pieces, a foot or two long, from two to six inches broad, and three or four lines in thickness; grayish-brown on the outer, and deep-cinnamon on the inner surface; of a rough fracture, and of a somewhat astringent, extremely bitter taste. Two alkaloids are said to have been obtained from it, called respectively *bebeerin* (bebeeria) and *sipeerin* (sipeeria); but as the two are extracted by the same process, Dr. Maclagan, of Edinburgh, who analyzed the bark, is inclined to believe that the latter is merely the result of an oxidation of the former. Like cinchona, nectandra also contains tannic acid, of the variety which forms a green precipitate with the salts of iron. *Bebeeria* is amorphous, and forms uncrystallizable salts with the acids. It is pale-yellow, of a resinous appearance, fusible and inflammable, without smell, very bitter, slightly soluble in water, and freely soluble in alcohol and in ether. It consists of carbon, hydrogen, nitrogen, and oxygen; but its formula has not been precisely determined. Sipeeria is also amorphous; but differs from the preceding alkaloid, in being insoluble in ether; so that, when it is desirable to separate the two, the object may be readily effected by means of ether, which removes the bebeeria, leaving the sipeeria behind.

Nectandra is tonic and astringent, with febrifuge virtues analogous, though inferior to those of cinchona. It is seldom used in any other form than that of sulphate of bebeeria, either impure, as generally found in commerce, or pure, as directed to be prepared in the British Pharmacopœia.

Sulphate of Bebeeria (BEBERIÆ SULPHAS, *Br.*) is prepared by treating the bark with water diluted with sulphuric acid, adding lime to the infusion thus obtained, but so as still to leave an acid reaction, then precipitating with ammonia, treating the precipitate with alcohol so as to dissolve the alkaloid, concentrating the alcoholic solution, neutralizing with sulphuric acid, and evaporating to dryness. For the details of the process, as well as for the method in which the impure sulphate of commerce is obtained, the reader is referred to *U. S. Dispensatory* (12th ed., pp. 1023 for the former, and 561 for the latter).

The impure sulphate is in thin, shining, brownish scales, becoming yellow when powdered, sparingly soluble in pure, but freely in acidulated water, and freely soluble also in alcohol. It has all the remedial effects of the bark, and may be given either in pill, or dissolved in water by the addition of a drop of diluted or aromatic sulphuric acid for each grain of the impure sulphate.

The sulphate of the British Pharmacopœia has the same sensible properties and probably differs little in any respect. The test of sufficient purity, given in the Pharmacopœia, is that "it is entirely destructible by heat; water forms with it a clear-brown solution; its watery solution gives with caustic soda a yellowish-white precipitate, which is dissolved by agitating the mixture with twice its volume of ether; and the ethereal solution separated by a pipette, and evaporated, leaves a yellow translucent residue, entirely soluble in dilute acids." Anything left undissolved by the ether is probably sipeeria.

The medical virtues of nectandra were first announced so early as 1834, by Dr. Rodie, after whom the specific name of the tree was adopted. But Dr. Douglas Maclagan was still more instrumental in giving it credit. It was for a time supposed that a substitute had been found for quinia in the alkaloid of this bark; and there can be no doubt that it will often prove efficacious in remittent and intermittent fevers; but experience has subsequently shown that it cannot be relied on; and its chief importance at present consists in the fact that, in the absence of the cinchona alkaloids, or where circumstances render their administration impossible, or when they have failed after trial, recourse may be had to sulphate of bebeeria, with good hopes of advantage. The dose is from two to five grains; and from a scruple to a drachm may be given between the paroxysms of an intermittent. The medicine may be given in pill or in slightly acidulated solution.

8. DOGWOOD.—CORNUS FLORIDA. *U. S.*

This is the bark of *Cornus Florida*, or common dogwood, a small indigenous tree, remarkable for its conspicuous white flowers, which render it one of the finest ornaments of our forests in the spring, as its glossy-red fruit, and leaves beautifully tinted by the frost, do in the autumn. The bark is taken indiscriminately from the root, stem, and branches; but that of the root is preferred. It is in pieces of various size, partially or completely rolled, sometimes with and sometimes without epidermis, of a reddish-gray colour, a feeble odour, and a bitter, astringent, slightly aromatic taste. It is brittle, and yields a gray, slightly reddish powder. Either water or alcohol will extract its virtues. These probably reside in a peculiar bitter principle, which, however, has not yet been isolated; for neither the *cornin* of Mr. Carpenter, nor the substance used, under the same name, by the eclectic physicians, so called, can be admitted to this rank. The bark contains also tannic acid, but not in sufficient proportion to give it any considerable medicinal activity.

The effects of dogwood on the system, so far as they can be traced, are those of a mild tonic and feeble astringent. It is said to increase the strength and frequency of the pulse, and the heat of the body; but, so far as known, it produces none of those effects upon the brain which characterize the action of Peruvian bark. In the recent state, it is said to act unkindly on the stomach and bowels; but, in this respect, it resembles most other tonics, when too freely administered.

Dogwood has been used almost exclusively, as a substitute for Peruvian bark, in the treatment of intermittent and remittent fevers; and, from the amount of testimony in its favour, there can be no doubt that it often has proved efficacious in the former of these complaints. But it has often also failed; and, since the introduction of sulphate of quinia into use, has been little employed by regular practitioners.

It may be used in powder or decoction. The dose of the powder in intermittents is stated at a drachm, so repeated as to amount to one or two ounces between the paroxysms. The U. S. Pharmacopœia directs a *decoction* (DECOCTUM CORNÛS FLORIDÆ, *U. S.*) to be made by boiling an ounce, in a pint of water, for fifteen minutes, then straining, and adding enough water, through the strainer, to make the decoction measure a pint. The whole pint may be taken in one intermission, in doses of two fluidounces. An *extract*, prepared with water or alcohol, might be substituted for either of the above forms with advantage. The profession is indebted chiefly to Dr. John M. Walker, who published a thesis on dogwood, in Philadelphia, in the year 1803, for what is known upon the subject.

The bark of two other indigenous species of Cornus, *C. circinata* or *round-leaved dogwood*, and *C. sericea* or *swamp dogwood*, have similar sensible properties, and are supposed to have the same medical virtues as that of C. Florida.

3. WILLOW BARK.—SALIX. *U. S.*

The barks of all the species of willow, possessing a very bitter taste, may be considered as designated by the title above given; for all probably have identical properties; but only that of *Salix alba* has been recognized by our national standard. This is the common European or white willow, and has been introduced into this country, where it grows extensively.

When dried, willow bark taken from the branches rolls into close quills, which are fibrous, flexible, and difficult to powder. It has a feeble, somewhat aromatic odour, and a peculiar bitter, astringent taste. Water and alcohol extract its virtues. The active ingredients are a peculiar principle called *salicin* and *tannic acid*, the latter of which, however, though in considerable proportion, is scarcely sufficient to entitle the medicine to rank among the proper astringents.

The effects of willow bark upon the system, so far as they are obvious, are those of a mild tonic and astringent; but it probably has also an antiperiodic action; as it has been used with some success as a substitute for Peruvian bark in intermittents. This, indeed, has been its chief employment; though it is not without efficacy in relaxed and debilitated states of the system, as in the weakness of convalescence, certain conditions of scrofula, passive hemorrhages, etc., in which a slight astringency is indicated along with a tonic influence. Like many other bitters, it has been used as an anthelmintic. The states of preparation in which it may be used are those of powder, infusion or decoction, and of salicin.

The *powder* is better borne by the stomach than cinchona and many other tonics. The *dose* of it for other purposes than those of an antiperiodic is half a drachm, repeated three times a day. As a substitute for Peruvian bark, in intermittents, it must be given, during a single intermission, in the quantity of one or two ounces, which may be distributed into doses of a drachm, repeated as often as may be necessary.

The *infusion* or *decoction* is made in the proportion of an ounce to the pint of water; and the dose is one or two fluidounces. From one to two pints must be given between the paroxysms of an intermittent. The decoction has been used as a topical application in indolent, flabby, or foul ulcers.

Salicin is by far the most efficient preparation in reference to the antiperiodic effect. Several processes have been suggested for its preparation. Among the best is that of Merck. The boiling concentrated decoction is treated with litharge, in order to precipitate various substances that tend to prevent the crystallization of the salicin. This principle remains in solution, probably holding a portion of the oxide of lead in combination. The lead is thrown down by the addition first of sulphuric acid, and then of sulphuret of barium; and the remaining liquid, being evaporated and allowed to cool, deposits the salicin, which is purified by repeated solution and crystallization. When pure, it is beautifully white, in minute, soft, shining, slender crystals, inodorous, and very bitter, with the peculiar flavour of the bark. It melts at 230°, and is inflammable at a higher temperature. It is soluble in water, much more so in hot than cold, is soluble also in alcohol, but not in ether, or the volatile oils. It is neuter in relation to acids and alkalies, and is not thrown down by any reagent. Sulphuric acid gives it a blood-red colour; but a more certain test is the odour of meadow-sweet (*Spiræa ulmaria*), which it yields when heated in solution with chromic acid; salicin being resolved by that acid into the oil of meadow-sweet or salicylous acid, among other products. Having been employed to adulterate sulphate of quinia, it is important that there should be some method of detecting it. When taken internally, it gives to the urine the odour of salicylous acid, into which it is probably converted in its passage through the system.

Since the discovery of salicin, this preparation has been almost exclusively used for obtaining the effects of willow bark. At one time, so favourable were the reports of its efficacy in intermittents, that the hope was indulged that it might supersede quinia. But further experience has shown that, though it will often cure intermittents, it cannot be relied on with certainty; and the best that can be said of it is that, when quinia cannot be obtained, it is among the best substitutes of vegetable origin. The dose as an antiperiodic is from two to eight grains, repeated so as to amount to from twenty to forty grains during the intermission. It is less apt to oppress the stomach than quinia.

4. HYDRASTIS.—HYDRASTIS. *U. S.*

Yellow-root, *orange-root*, and *yellow puccoon* are the common names by which this medicine, as well as the plant producing it, have been long known in this country, and which have been officinally superseded by the title, both English and Latin, which has been adopted in the U. S. Pharmacopœia. Already it is probably better known, among the profession, by the name of hydrastis than by any of its vernacular titles. It is the product of *Hydrastis Canadensis*, an indigenous plant, widely distributed throughout most of the United States, especially the North and West. It is a perennial herb, with a thick, fleshy, yellow root-stalk, which sends out numerous radical fibres, and from which rises annually an erect pubescent stem, from six to twelve inches high, bearing near the top two unequal, generally five-lobed, pubescent leaves, and a solitary rose-coloured or purplish flower. The fruit resembles the raspberry, but should not be eaten. It prefers moist and rich woodlands. The root has long been known as a domestic remedy, and has been much used by irregular practitioners; but did not become officinal until the late revision of the Pharmacopœia, when it was introduced into the secondary list of that work. It merits, however, a place in the primary catalogue, and will probably receive it at the next revision.

The dried root, which has shrunk much in desiccation, is irregularly contorted, rough and wrinkled, one, two, or three inches long by two or three lines in thickness, with numerous slender rootlets, or the marks where they have been broken off. It is externally of a yellowish colour becoming dark-brown by age, is internally yellow, and yields a yellowish powder. The odour is strong, sweetish, and somewhat narcotic, the taste peculiar but bitter. Water and alcohol extract its virtues. These probably reside partly in a volatile oil, but much more in two alkaloids, *hydrastia* or hydrastin, originally discovered by Mr. Alfred A. B. Durand, of Philadelphia, and *berberina*, a principle long known as existing in the root of Berberis vulgaris, but first recognized by Mr. F. Mahla as being the second alkaloid of hydrastis. This latter alkaloid has since been detected in other vegetable remedies, especially columbo; and the large proportion in which it exists in hydrastis proves that this medicine must have virtues analogous to those of the African root.

For the modes of preparing, and for the characteristic properties of these two alkaloids, I must be content with referring to the 12th edition of the U. S. Dispensatory. It is sufficient here to state that hydrastia crystallizes in shining four-sided prisms, which are white or colourless when pure, inodorous, nearly tasteless in consequence of difficult solubility in the saliva, nearly insoluble in water, but readily dissolved by alcohol and ether; while berberina is in minute acicular crystals, having in mass a yellow colour, soluble in 100 parts of cold water, less soluble in alcohol, and insoluble in ether, of a decidedly bitter taste, and characterized by the property of forming with muriatic acid a yellow salt, of very difficult solubility.

Medical Properties. Hydrastis is decidedly tonic, as might be inferred from its partial resemblance to columbo in composition. It is also aperient; and this property may be ascribed to the berberina, which is the characteristic ingredient of a root long used for its aperient properties, that, namely, of Berberis vulgaris. But it is asserted also to be cholagogue, deobstruent in its influence on enlarged glands, diuretic, alterative, etc. There can, I think, be little doubt that the alkaloid hydrastia has special remedial powers; and, if further experience should confirm the opinion, that it peculiarly promotes the hepatic secretory function, it will be an invaluable addition to the materia medica, enabling us to dispense in many instances with the use of mercury, otherwise indispensable. The affections in which it has been specially employed are dyspepsia, particularly when attended with deficient action of the liver, jaundice and other functional diseases of the liver attended with deficient secretion, constipation with or without piles, and generally chronic inflammation of the mucous membranes, in which it is supposed to act as an alterative like the mercurials. But much more experience, and a careful comparison of detailed reports from regular practitioners, above the suspicion of interested motives, are necessary, in order to justify a positive determination as to the merits of this very promising medicine.

5. BARBERRY.—BERBERIS. *U. S.*

The bark of the root of *Berberis vulgaris* is the part designated in the U. S. Pharmacopœia as officinal. The plant is a shrub, sometimes attaining the size of a small tree, indigenous in Europe, but growing wild in various parts of our own country, as in New England and on the banks of the Hudson. A species of the genus, designated by Pursh as *Berberis Canadensis*, grows in our country from its northern boundaries to the Carolinas. Hooker, however, considers it as merely a variety of B. vulgaris; and, whatever may be the fact on this point, there can be little doubt that it possesses the same medical virtues.

The bark of the root is grayish on the outer, and yellow on the inner surface; is very bitter, staining the saliva yellow when chewed; and yields its virtues and colouring properties to water and alcohol. Long employed in medicine, it never enjoyed a very high reputation, and seems to have fallen into almost entire neglect; but, when it was ascertained to contain a peculiar alkaloid, and that alkaloid found to be diffused among various other medicines, some of them very greatly esteemed, as columbo, xanthorrhiza, xanthoxylum, hydrastis, etc., attention was again forcibly drawn to it, with the result of introducing it into the present edition of our Pharmacopœia, though in the secondary catalogue. For the method of extracting berberina from the bark, I must refer to the U. S. Dispensatory (12th ed., p. 168). Of the alkaloid itself, the most important and characteristic properties may be given in a few words. When obtained by crystallization from the hot solution, resulting from the decomposition of its sulphate by means of oxide of lead, added to a heated solution of that salt, it is in the form of a yellow powder, shown by the microscope to consist of groups of minute acicular crystals. It is inodorous, bitter, soluble in 100 parts of cold water, and requiring still more of cold alcohol, but freely dissolved by both these liquids with the aid of heat, and insoluble in ether. Its most characteristic property is probably that of being copiously precipitated by muriatic acid from its solution in cold water, owing to the very difficult solubility of the resulting muriate. This property, taken in connection with the bright-yellow colour of the muriate, is sufficient to distinguish berberina from all other alkaloids. Notwithstanding the very difficult solubility of the muriate in cold water, yet enough is dissolved to produce a deep-yellow colour. Another alkaloid has also been found in the root for which the name of *vinetina* has been proposed. But little is known of its physiological properties. Both alkaloids consist of carbon, hydrogen, nitrogen and oxygen; but their precise atomic composition can scarcely be said to have been yet determined, though that of berberina has been given as $C_{40}H_{17}NO_8$, of vinetina $C_{32}H_{20}NO_{11}$.

Barberry is tonic, and when freely given, cathartic, with a supposed action on the liver. It has been used in intermittent fever, dyspeptic affections with constipation, and in jaundice. Whether it has any real influence on the liver is not yet determined, and would form a good subject for careful inquiry. It was probably first introduced into the treatment of jaundice on the doctrine of signatures, which implies a certain relation between the sensible properties of the medicine and those of the part diseased, or some product of the disease; as, in this case, between the yellowness of the bark and that of bile. But, baseless as this principle is, some medicines introduced into use on the grounds of it, have retained their place from their real virtues; and the same may possibly be the case with barberry.

◆

The substances which follow, belonging to the subdivision of bitter tonics of peculiar properties, owe their peculiarity in general to the association of some other active constituent with their bitter principle. This associated constituent is, with one or two exceptions, a stimulant volatile oil. The most decided exception to this general rule is afforded by the wild-cherry bark, in which, though a somewhat stimulating volatile oil is always generated when it is exposed to the action of water, whether within the stomach or out of it, yet, in connection with this oil, a powerful sedative is also produced, hydrocyanic acid, namely, to which the medicine is mainly indebted for its peculiar and characteristic effects.

II. HOPS.

HUMULUS. *U.S.*—LUPULUS. *Br.*

Origin. Hops are the fruit or strobiles of Humulus Lupulus, a climbing perennial plant, growing wild in Europe and North America, and largely cultivated in both continents. The fruit is picked when ripe, dried by artificial heat, packed in bales, and thus sent into market.

Sensible Properties. Each strobile has the shape of a cone flattened by pressure, and consists of a number of thin, translucent, leaf-like scales, one overlapping another, of a pale yellowish-green colour, with two small black seeds near the base of each, and minute yellowish granules upon their surface, easily separable when the fruit is quite dry. Hops are of difficult pulverization, of a strong, peculiar, narcotic, yet fragrant odour, and of an extremely bitter, aromatic, somewhat astringent taste. They impart their sensible and medicinal properties to alcohol and water.

Active Constituents. The virtues of hops depend probably, in chief, upon a peculiar bitter principle called *lupulite* or *lupuline*, but to which the name of *humulin* would be more appropriate, as more distinct from *lupulin*, which had been introduced into use, with another meaning, before the discovery of the principle referred to. They contain also a *volatile oil*, which is the source of their aroma, and a small proportion of *tannic acid.* According to Mr. W. Jauncey, the oil is formed in the hops during desiccation, as he has failed to discover it in fresh strobiles. (*Edin. Med. Journ.*, iii. 699.) Their other constituents have no special interest for the physician.

The active principles of hops are diffused, in some degree, throughout their whole substance, but are mainly concentrated in the yellowish granules upon the surface of the scales. These granules are separated for use, and constitute a distinct medicine, recognized in our Pharmacopœia by the name of lupulin, proposed for it by the late Dr. A. W. Ives, of New York, who first brought it into notice.

LUPULIN (*Lupulina*, U.S.) is prepared by rubbing or threshing the hops, and then sifting the coarse powder obtained. It consists of yellowish granules, almost always interspersed with minute fragments of the scales themselves, from which it is impossible entirely to separate them, as ordinarily procured. Lupulin has the odour and taste of hops, and contains the volatile oil and bitter principle above mentioned, with mere traces of the tannic acid. As it possesses all the virtues of hops, in a more concentrated and convenient form, it is generally preferred for internal use.

Effects on the System. Notwithstanding the vast consumption of hops in malt liquors, their effects on the system, and mode of operation, have not yet been thoroughly investigated, or satisfactorily determined. That they are tonic to the digestive function is generally admitted, and might be inferred from their intense bitterness. Almost universal experience would seem to have determined that they have the additional property of inducing heaviness, drowsiness, and even sleep; and by most they are believed to have that also, in some degree, of relieving pain. Nevertheless, Magendie was disposed to reject their claim to be considered narcotic, having given lupulin to the lower animals without any such effect; and others are not wanting who maintain the same opinion. Dr. Maton, however, found them to allay pain, produce sleep, and lower the pulse in twenty-four hours from 96 to 60 in the minute. (Pereira, *Mat. Med.*, 3d ed., p. 1247.) Dr. William Byrd Page, of this city, in February, 1849, stated to the College of Physicians of Philadelphia, that he had found lupulin to possess extraordinary powers in allaying irritation of the genital organs, and had been in the habit of using it for that purpose for two years. The same fact has since been confirmed, on the continent of Europe, by Zambaco, who was induced to make experiments with it by an observation of Debout, in relation to its favourable influence in relieving painful erections. He gave from one to sixteen scruples, without producing disturbance of the nervous system, but with decided effects, of the nature referred to, on the genital organs. (See *Lond. Med.*

Times and Gaz., Feb. 1855, p. 118.) With their tonic, soporific, and anodyne properties, hops may, therefore, be considered antaphrodisiac. That they possess the power of stimulating the cerebral functions is extremely doubtful; and I am not, therefore, disposed to class them in the same category with opium and alcohol. From the large quantities taken with impunity, it is probable that their influence over the brain is feeble, and, from the symptoms evinced, that it is rather sedative than stimulant. In this uncertainty as to the precise position they ought to occupy, in reference to their influence over the nervous system, I have thought it best to rank them with the division of bitter tonics having peculiar properties, to which they undoubtedly belong, whatever claim they may have to a position elsewhere.

Opinion is not more settled as to the special influence of the several active principles of hops. It has been a prevalent impression that the odorous and volatile principle is that to which they owe their narcotic properties. The effect of a pillow of hops in producing sleep may be said to be almost notorious; and it is asserted that stupor has sometimes occurred in persons who have remained long in warehouses containing hops; but, in the former case, much allowance must be made for the operation of the patient's imagination; and, in the latter, it might be suggested that the experience of such an effect, if real, should be more than occasional, and that there might have been some other cause for the stupor when observed. Besides, Dr. Wagner states that he gave twenty drops of the volatile oil to a rabbit without observable effect. (*Chem. Gaz.*, July 15, 1853.) In reference to the bitter principle, there is little more certainty, except as to its tonic action on the digestive organs. Dr. Christison is disposed to think, that whatever soporific virtues may be possessed by hops reside in the volatile oil, and consequently that the bitter principle is destitute entirely of narcotic properties. (*Dispensatory.*) Mr. Walter Jauncey, as the result of his experiments, found the oil to relieve pain, without necessarily producing sleep, and, in large doses, to reduce the frequency of the pulse considerably, and induce headache, anorexia, and nausea; and it acts in this way whether taken into the stomach, or inhaled. He also found it to act as a diuretic, and to allay the venereal appetite. His general conclusion was, that the oil is sedative and anodyne, and that humulin, or the bitter principle, is merely tonic. (*Ed. Med. Journ.*, Feb. 1858, p. 701.) Like all other bitters, hops are offensive to the stomach in over-doses.

Therapeutic Application. Hops may be used as a tonic in dyspeptic or debilitated states of the digestive organs, and are specially indicated in cases attended with nervous restlessness and want of sleep. This condition not unfrequently exists in the convalescence from acute diseases, and in persons of a nervous temperament, who have been exposed to the influence of other debilitating causes. On any occasion of obstinate wakefulness, dependent on mere nervous disturbance, hops may be tried among other means of relief, and especially when some objection may exist to the use of opiates. They are supposed sometimes to have operated usefully in the morbid vigilance of insanity. In all these cases, a dose of the infusion of hops, of lupulin, or, when stimulation is also indicated, of one of the tinctures, may be given three or four times a day.

But the case to which hops are probably most appropriate is that of the inebriate, suffering under the want of his accustomed stimulus. The medicine appears sometimes to operate most happily in such cases, in supporting the digestive function, controlling nervous tremors, obviating hallucinations, and disposing to sleep. Unassisted by stimulants, it is not adequate to supply the want of alcoholic drinks altogether; but, in the form of malt liquors, or that of the tincture of hops or of lupulin, it will, I believe, often enable the patient to escape the horrors of delirium tremens, with a smaller amount of alcoholic stimulus than would otherwise be necessary. In delirium tremens itself, the tincture is often an admirable adjuvant to opium; and I feel confident that I have seen sleep induced by it, in cases of this kind, which resisted the opiate treatment, without any reason for ascribing the result merely to the alcoholic ingredient. In convalescence, moreover, from that disease, it is one of our best remedies for sustaining a moderate tonic and soporific influence over the patient, until nature shall have recovered her powers. In these conditions, the tincture of lupulin may be given in the dose of half a fluidounce every two or three hours in the beginning, to be gradually diminished, and with lengthened intervals, as it may cease to be requisite, either for supporting strength, or producing sleep.

Dr. Maton found the medicine useful in allaying the pains of acute rheumatism; but it is vastly inferior to opium for this purpose.

It has occasionally been used in *intermittent fever* without very encouraging success; but has recently been recommended in that complaint by Dr. W. Y. Godberry, of Benton, Miss., as equal to any other article of the Materia Medica except quinia; and he has often succeeded in arresting the disease by means of it, after that medicine had failed. He prefers the infusion, which should be made with an ounce to a pint of boiling water; the whole to be taken during the intermission. (*Am. Journ. of Med. Sci.*, N. S., xxvi. 283, from *West. Journ. of Med. and Surg.*, March, 1853.)

From the statements of Dr. Page before referred to, lupulin would appear to be one of the best remedies in our possession for relieving irritations of the genital organs in men. In the painful erections occurring in gonorrhœa, he gives it in doses of from five to ten grains, and has never known an instance in which the second dose did not afford relief. He has also found it useful in spermatorrhœa; preventing the discharges while the patient is under its influence, though inadequate to the cure.

These statements of Dr. Page have been confirmed by subsequent observers. I have myself witnessed, in irritation of the urinary organs, very beneficial effects resulting apparently from the use of lupulin.

Administration. Hops are seldom if ever given in substance. The *Infusion* (INFUSUM HUMULI, *U. S.*), which is made in the proportion of half an ounce to a pint of boiling water, may be given in the dose of a wineglassful. Decoction is an unsuitable mode of preparation, as boiling dissipates the volatile principle, on which probably the virtues of the hops partly depend.

The *Extract* (EXTRACTUM LUPULI, *Br.*) is liable to the same objection as the decoction. It has the bitterness without the aroma of the hops. Nevertheless, it is said to have acted as an anodyne and soporific; but it has been almost entirely superseded by lupulin, which has all its advantages without its defect. The dose of the extract is from ten to thirty grains.

A *Fluid Extract* and an *Oleoresin of Lupulin* (EXTRACTUM LUPULINÆ FLUIDUM, *U. S.*, and OLEORESINA LUPULINÆ, *U. S.*) were introduced into the present edition of our national code. The former is a very concentrated tincture of lupulin, the latter a semiliquid ethereal extract. Both of these preparations may be considered as representing the virtues of hops. The dose of the former is ten or fifteen minims, of the latter from two to five grains. The oleoresin is most conveniently given in the form of pill, made up with powdered liquorice root.

Lupulin is now probably most used when the influence of hops is wanted. The dose is from six to twelve grains; but may be much increased, if thought advisable. It is most conveniently given in pill, which may be made by rubbing the powder, in a warm mortar, till it acquires a plastic consistence.

The *Tincture of Hops* (TINCTURA HUMULI, *U. S.*, TINCTURA LUPULI, *Br.*) is not an eligible preparation, being too feeble and uncertain to be relied on. The usual dose is from one to three fluidrachms.

The *Tincture of Lupulin* (TINCTURA LUPULINÆ, *U. S.*) is more efficient, and is an excellent preparation when the alcoholic ingredient is not objectionable. The dose for ordinary purposes is one or two fluidrachms.

III. WILD-CHERRY BARK.

PRUNUS VIRGINIANA. *U. S.*

Origin. This is the inner bark of *Cerasus serotina*, or *wild-cherry*, a large indigenous tree, growing abundantly in the Middle and Western States. The officinal name originated in the mistaken supposition, that the *Prunus Virginiana* of Linnæus was the tree in question; whereas, according to Torrey and Gray, that title really belongs to the *choke-cherry* (*Cerasus Virginiana* of the N. American Flora), a small tree or shrub, inhabiting the Northern States. The bark is obtained from the root, stem, and branches of the tree; but that from the root is preferred. It should be collected in the autumn, when it is strongest. The recently dried bark is more efficacious than that which has been long kept.

Sensible Properties. Wild-cherry bark, as found in the shops, is usually destitute of epidermis, of a reddish-yellow colour, brittle, and easily pulverized, yielding a fawn-coloured powder. When fresh, or treated with water, it has the odour of peach-leaves. The taste is agreeably bitter, astringent, and somewhat aromatic. It yields its bitterness to water, to which it imparts a reddish-brown colour like that of Madeira wine.

Active Constituents. Among the active principles existing in the bark are *amygdalin* and *tannic acid.* There is probably also some *emulsin*, a kind of nitrogenous or albuminous matter, found in the bitter almond, where it plays an essential part in changes, analogous if not identical with those which are now to be noticed as occurring in wild-cherry bark. When this bark comes in contact with water, a reaction takes place, under the influence of the emulsin operating as a ferment, between the water and the amygdalin of the bark, whereby the latter is converted into a peculiar volatile oil and hydrocyanic acid, which may be obtained together by distillation, constituting a product which is probably identical with the *volatile oil of bitter almonds.* When, therefore, wild-cherry bark is used in the form of infusion, it is not merely the amygdalin and tannic acid which act, but the new product also, which is essentially, in relation to its effects on the system, the hydrocyanic acid; for the volatile oil which attends it has little effect. When the medicine is taken in the form of powder, it is highly probable that the same change takes place in the stomach, under the reagency of the water there. It is a question whether the bark does or does not contain a bitter principle distinct from amygdalin. I believe that it does so, not only from its tonic effects, which cannot be ascribed either to the volatile oil or hydrocyanic acid, but from an experiment made at my request by Professor Procter, which appears to determine the question.* Though boiling water will extract the active matters existing in the bark, yet cold water is medicinally the best solvent; for the emulsin is coagulated and rendered inert at a high temperature, and the formation of hydrocyanic acid consequently prevented.

---

* A portion of the bark was exhausted by alcohol, and the tincture evaporated to an extract. This contained the amygdalin, and whatever bitter matter and tannic acid existed in the bark. The extract was triturated with water, and with gelatin to remove the tannic acid. The liquor being then filtered, was mixed with an excess of the emulsion of sweet almonds, containing of course the *emulsin* necessary for causing reaction between the amygdalin and water. A strong odour of hydrocyanic acid was produced, which had not previously existed in the solution of the alcoholic extract. As the emulsin was in excess, the whole of the amygdalin must have been destroyed. The liquid was evaporated to a soft extract, and mixed with water. Sweet almond emulsion now added generated no more hydrocyanic acid,

Effects on the System. Wild-cherry bark is, through its bitter principle, a gentle stimulant to the digestive and probably to the nutritive function; while the hydrocyanic acid, evolved by the reaction of water with the amygdalin, renders it sedative to the nervous system, and, when freely taken, to the general circulation. Dr. Eberle states that, in his own person, he has "several times reduced his pulse from seventy-five to fifty strokes in the minute by copious draughts of the cold infusion, taken several times a day, and continued for twelve or fourteen days." (*Mat. Med. and Therap.*, 4th ed., i. 301.)

Therapeutic Application. The joint tonic and sedative properties of this bark admirably adapt it to the treatment of cases of general debility, with enfeebled digestion, an irritable state of the nervous system, and excessive frequency of pulse. Long before its chemical peculiarities were discovered, experience had established this application of the remedy. In the treatment of *pulmonary consumption*, it has for many years been a favourite in this country, and, before cod-liver oil came into notice, was probably more relied on than any other single medicine. It was employed not only in the advanced stages when hectic fever had set in, but from the beginning, and often as a preventive, in cases in which a strong tendency to the disease seemed to be displayed. It was given with the view of imparting tone to the digestive organs and system generally, and thereby modifying the tuberculous diathesis, and was preferred to other tonics, because it was thought to produce these effects with less danger of undue excitement. Now that it is known to be positively sedative to the heart, and to the nervous system, we can better understand its usefulness in that complaint. In other forms of *scrofulous disease*, presenting a similar complication of debility of the digestive and nutritive functions with frequency of the pulse, it is equally indicated. Few remedies are better adapted to *hectic fever*, from whatever source it may proceed. In the debility of *convalescence from fevers*, and other severe acute diseases, when attended, as it often is, with night-sweats, a frequent pulse, and sleeplessness, restlessness, or other functional nervous disorder, the wild-cherry bark is also an excellent remedy. Perhaps the tannic acid it contains may contribute to its usefulness in correcting the excessive sweating in these cases; but I am not inclined to attribute much to that principle in estimating the virtues of the bark.

It has been recommended also in simple *dyspepsia*, and as an anti-

---

and there was none of the peculiar odour of that product; yet the taste was decidedly bitter, proving the existence in the bark of a bitter principle distinct from amygdalin.

periodic in *intermittents*; but in the former it is much inferior to the pure bitters, and in the latter, though sometimes successful, it very often also fails, and is not comparable in efficacy with Peruvian bark. It may be employed, however, in cases of convalescence from miasmatic fevers, in which there is a strong tendency to relapse, and in which a long continuance of the preventive influence may be necessary for the eradication of the predisposition. In such cases, though less effectual than sulphate of quinia, it may perhaps be safer.

I have employed the remedy much in *functional and organic disease of the heart*, attended with a frequent, perhaps irregular, but rather feeble pulse, with an anemic or otherwise debilitated state of system; and consider it one of our best remedies in such cases, combined, if anæmia exist, with the use of the chalybeates. As the infusion, however, contains tannic acid, it is better not to add the preparation of iron to it, but to administer the two separately.

Administration. The bark may be given in the form of powder, infusion, or syrup. The powder is seldom used, because less convenient, more apt to oppress the stomach, and less likely to undergo those chemical changes which are essential to the characteristic effects of the remedy. The dose is from thirty grains to a drachm, which may be repeated three or four times daily.

The *Infusion* made with cold water (INFUSUM PRUNI VIRGINIANÆ, *U. S.*) is the most appropriate form. It is made in the proportion of half an ounce to the pint of water, and is best prepared by the process of percolation. Any one can perform this process. Introduce an ounce of the bark, in the state of powder, into a common funnel, pack it somewhat closely, and pour upon it a quart of cold water; the point of the funnel being inserted into the mouth of a glass decanter. When the water has all passed, pour it back into the funnel, and repeat this measure until the liquid acquires the colour of Madeira wine. Two fluidounces of the infusion, thus prepared, may be given three or four times a day, or more frequently when a strong impression is desired.

A *Syrup* (SYRUPUS PRUNI VIRGINIANÆ, *U. S.*) is directed by our Pharmacopœia. It is an elegant preparation, and, where there is no contraindication, from delicacy of stomach or other cause, to the use of so much saccharine matter, may be substituted without disadvantage for the infusion. The dose is half a fluidounce, to be repeated as directed for the other forms.

A *Fluid Extract* (EXTRACTUM PRUNI VIRGINIANÆ FLUIDUM, *U. S.*) was introduced into the last edition of the Pharmacopœia. It is prepared according to a very ingenious process suggested by Professor Procter, by which the virtues of the bark are obtained in a very concentrated form. The dose is one or two fluidrachms, equivalent to half a drachm or a drachm of the bark in substance. (See *U. S. Dispensatory*, 11th ed., p. 628.)

Wild-cherry bark should not be prepared in the form of tincture, extract, or decoction. In reference to the two latter, independently of the chemical objection above stated, there is another in the volatile character of the hydrocyanic acid, which, if formed, would be driven off, to a greater or less extent, in the processes for their preparation.

IV. CHAMOMILE.

ANTHEMIS. *U. S.*, *Br.*

Origin. The chamomile of the shops consists of the flowers of *Anthemis nobilis*, a perennial, herbaceous plant, growing wild in Europe, where it is also cultivated for use. Though it has been introduced into our gardens, none of the chamomile of the shops is produced in this country. All parts of the plant have medicinal properties; but it is only the flowers that are officinal. They are imported from Germany and England.

Varieties. The flowers of chamomile are compound, consisting, in their perfect state, of a central yellow disk, with a circle of white ray florets around it. There are two varieties, distinguished as the *single* and *double*; the former retaining their yellow central disk florets, the latter having had these converted by cultivation into white ray florets. But the distinction is not precise; for there is a large proportion of the flowers in which this conversion is incomplete; and, as found in the shops, there is generally a mixture of the single and double flowers, and others in the intermediate state. In most parcels, as brought to this country, the double or white flowers greatly predominate. The single or yellow, however, are more odorous, and more stimulant to the stomach, because the volatile oil, upon which these properties depend, is much more abundant in the central or yellow florets.

Sensible Properties. The odour of chamomile is fragrant and peculiar, the taste bitter, warm, and somewhat aromatic. It yields these properties, and its medical virtues, to water and alcohol.

Active Constituents. With a minute proportion of tannic acid, which is therapeutically of no account, the flowers contain a *bitter principle* and *volatile oil*, upon which their medical virtues depend. It is said that they yield also, on distillation, in very small proportion, a substance resembling valerianic acid.

Effects on the System. In small doses frequently repeated, chamomile is a mild tonic, operating like the simple bitters, but with a somewhat more excitant influence on the stomach, owing to its volatile oil. In large doses it is apt to prove emetic, more so probably than the simple bitters, which it resembles in its tonic effects.

Therapeutic Application. Chamomile has been employed as a medicine from the earliest times. On the continent of Europe, it is distinguished by the name of *Roman chamomile*. It is particularly adapted to cases of general debility, in which the stomach participates in a greater degree than other organs. The gentle stimulant influence of its volatile oil on the stomach renders it peculiarly applicable under such circumstances. Hence, it is much used in the convalescence from acute febrile diseases. In mild dyspepsia, with defective appetite, flatulent eructations, or slight colicky pains from wind in the stomach or bowels, it may often be given with advantage. Its general mildness and harmlessness adapt it to those slight cases of debility, frequently occurring, especially in sedentary females, in which stronger medicines are scarcely required, and might prove hurtful.

By the ancients it was used in the treatment of intermittent fever, and continued to be esteemed among the most valuable remedies in that complaint, down to the period of the discovery of Peruvian bark. Even after that period, it long continued to retain some reputation as a febrifuge, being employed in cases which resisted the bark, and especially in the remission of remittent fevers, before the febrile phenomena of the paroxysms had sufficiently subsided to justify the use of the more powerful antiperiodic. But, since the introduction of sulphate of quinia into use, this application of chamomile has been generally abandoned; as it is now understood that, in miasmatic remittents, when there is a sufficient abatement of the fever to justify a resort to the bitter tonics, quinia may almost always be used, with equal safety, and vastly greater effect. In cases, however, of intermittent and remittent fever, distinctly paroxysmal, in which circumstances may prevent the employment of cinchona or its preparations, large draughts of warm chamomile tea, given immediately before the paroxysm, the patient being kept warm in bed, will sometimes prevent the recurrence of the fever, either by operating as an emetic, or by a joint tonic and diaphoretic action.

It has already been stated that, in large doses, chamomile is apt to vomit. To produce this effect, however, it should be given in the form of warm infusion, and in large draughts, so as to aid the medicine by the nauseating effects of tepid water. It may frequently be employed with advantage, in this way, in cases of gastric spasm arising from undigested food or other irritating matters in the stomach, and attended with sensations of nausea, or ineffectual efforts to vomit. Indeed, in any case of irritable stomach, when that organ seems unable wholly to free itself from its contents, it may very properly be aided by large draughts of warm chamomile tea. In febrile and bilious diseases, there is often a good deal of retching from the presence of acrid bile in the stomach, which may thus be promptly relieved. The tea is often also administered along with other emetics, or shortly afterwards when they are tardy, in order to promote their action, or to render it more easy to the patient, by giving the stomach a greater bulk to act upon.

The flowers were formerly much used externally with hot water, in the way of fomentation, or as a sort of cataplasm inclosed in a flannel bag. They add nothing to the virtues of the hot water; but, in the latter case, may be useful by absorbing the liquid.

Administration. Chamomile is given in powder, infusion, or extract; and the volatile oil is sometimes separately administered.

The powder was formerly given occasionally, with the view to the antiperiodic effect, in doses of from half a drachm to a drachm, repeated three or four times a day, or oftener if required. As a mere tonic, its dose may be stated at from ten to thirty grains; but it is almost never administered in this way. The flowers themselves are sometimes chewed by dyspeptic persons, and by those who wish to break themselves of the habit of chewing tobacco, by substituting a more innocent substance.

The *Infusion* (INFUSUM ANTHEMIDIS, *U.S.*) is made in the proportion of half an ounce to a pint of water. When time is allowed for a sufficient maceration, cold water is preferable to hot as the menstruum, as it yields an infusion more acceptable at once to the palate and the stomach; but in case of haste, boiling water may be used; and, with a view to its emetic operation, the latter is decidedly preferable, and the infusion should be taken warm. The dose as a tonic is a wineglassful, three or four times a day. When given to aid emetics, a small bowlful, containing from six to twelve fluidounces, may be given at once, and repeated if required.

The *Extract* (EXTRACTUM ANTHEMIDIS, *Br.*), directed by the British Pharmacopœia, is not an ineligible preparation; as the volatile oil, which was driven off in the old Edinburgh process during the evaporation, or rather an equivalent quantity of it, is added at the close of the concentration. As now prepared, the extract represents the virtues of the flowers, and may be given whenever these are indicated. It is occasionally used as an addition to laxatives or metallic tonics, and as a vehicle for other medicines, given in the pilular form. The dose is from five to thirty grains, the strength being about double that of the flowers.

The *decoction* was formerly used as an external fomentation, as an enema, or as a local application to flabby or indolent ulcers; but has been abandoned, because in no respect preferable to the infusion, and inferior from the circumstance, that a portion of the volatile oil must be driven off in its preparation.

The *Volatile Oil* (OLEUM ANTHEMIDIS, *Br.*) is occasionally prescribed. It is obtained by distillation with water from the flowers. As first procured, it has a sky-blue colour, which is changed by time to yellow or brown. Its odour is that of chamomile, its taste pungent and aromatic. It is stimulant to the stomach, and may be given in gastric pains of a purely functional character, and in flatulence, in the dose of five or six drops. It is sometimes associated with purgatives to prevent griping.

Other species of Anthemis have been used. *A. Cotula, may-weed*, or *wild chamomile*, which grows abundantly in this country, and is one of the most common weeds in our public roads, has virtues analogous to those of A. nobilis, but, in consequence of its very unpleasant odour, is little if at all used with us. In Europe it is said to be occasionally employed as an antispasmodic and emmenagogue. Our national Pharmacopœia recognizes it, in the secondary list, under the name of *Cotula*.

GERMAN CHAMOMILE.—MATRICARIA. *U. S.*

This medicine is considered here in a subordinate position to Anthemis, because, though closely similar to the common or Roman chamomile, and largely used on the continent of Europe, and especially in Germany, for the same purposes, it is probably inferior in strength, and is little used in this country unless among German practitioners. The plant is an annual syngenesious herb, of which the flowers only are officinal. As found in our shops they are imported from Germany. They are smaller than the common chamomile, and the yellow disk or central florets, which are deep-yellow, are proportionably more numerous than those of the ray. They owe their virtues to a volatile oil and bitter principle, both of which are readily imparted to water and alcohol. Their effects are essentially the same as those of common chamomile, and they are given for the same purposes, and in the same way.

◆

V. THOROUGHWORT, OR BONESET.

EUPATORIUM. *U. S.*

Origin. This consists of the leaves and flowering tops of *Eupatorium perfoliatum*, an indigenous, perennial, herbaceous plant, growing abundantly, usually in clusters, in low moist grounds, in most parts of the United States. All portions of the plant are medicinal. It is in flower from July to October, and should be collected during that period.

Sensible Properties. Boneset is sometimes kept in the shops in bunches, sometimes in small oblong packages, in which it is much broken up. In the former state, it may be known by its perfoliate and decussating leaves, and by its flattish, dense summit of white, almost feathery flowers. The leaves may be considered as consisting of two, joined at their base, where they are perforated by the stem. Each leaf is broadest at the base, long, narrow, and gradually tapering to a point, serrate on the edges, wrinkled, whitish below and green above, and hairy. The pairs are so placed on the stem, that each one is at right angles with the one above and below it. The odour is feeble, yet distinct, and the taste strongly bitter and peculiar. It yields its sensible and medicinal properties to water and alcohol.

Active Constituents. Little is known, positively, on this point. There is little doubt that the bitterness resides in one or more proximate principles; but they have not yet been satisfactorily isolated. From the smell, it may be inferred to contain a small proportion of volatile oil, and the fact seems to have been established by the examination of Mr. Bickley. (*Am. Journ. of Pharm.*, xxvi. 495.) The medicine is placed next to chamomile, more from its analogy to that medicine in effects, than from any known resemblance in composition.

Effects on the System. Eupatorium, in moderate doses, produces on the system effects like those of the simple bitters; but superadds to these, especially when taken in warm infusion, and somewhat freely, a decided diaphoretic action. It is said, also, sometimes to be diuretic, and, in large doses, proves emetic and laxative. It is among the remedies derived from the aborigines, from whom it passed into popular use, and thence into the hands of the profession.

Therapeutic Application. Eupatorium may be given, like the simple bitters, in *pure dyspepsia* or *general debility;* but, being more liable than they to irritate the stomach, and probably less efficient as a mere tonic, should not be allowed to supersede them, unless under peculiar circumstances of idiosyncrasy or prejudice. Dr. Burgon, of Bucks County, Pennsylvania, preferred it to all other tonics, in the loss of appetite incident to the abuse of alcoholic drinks. (*Am. Med. Record.*, iii. 331.) Dr. Eberle found it peculiarly useful in the indigestion of old people, in whom, while it restored tone to the stomach, it rendered the skin soft and comfortable. (*Mat. Med. and Therap.*, 4th ed., ii. 219)

But its highest reputation has been *as a febrifuge.* From the inaugural dissertation of Dr. Anderson (New York, 1813), it would appear to have been employed with very great success, in the treatment of intermittents, in one of the New York hospitals. Subsequent observation of its effects has proved less favourable; and, employed as a mere antiperiodic, in the ordinary mode of prescribing bark or quinia in the intermissions, it cannot be relied on. But I have known it to supersede the paroxysms of intermittent fever, when given in emetic doses, in the state of strong tepid infusion, shortly before the period for the return of the chills; and if, jointly with this method of exhibition, it be administered in moderate doses, at short intervals, during the apyrexia, there is little doubt that it will often prove successful. Still, it is greatly inferior to sulphate of quinia in certainty, while, in its effects as thus used, it is much more disagreeable. It may be very appropriately tried in obstinate and frequently recurring attacks of intermittent fever, in which quinia has become offensive to the patient, or inoperative from repetition. The same remarks are applicable to its comparative efficacy in remittents; in which, however, its tendency to produce perspiration is somewhat in its favour.

It was recommended, by Drs. Bard and Hosack, in yellow fever (Eberle, *loc. cit.*); and has been used as a tonic and diaphoretic in low fevers, and typhoid pneumonia; but its special merits in these affections are at best equivocal, and it is now seldom employed.

Perhaps its best application is to the treatment of *catarrahal affections*, more particularly the epidemic catarrh or *influenza*, which is frequently attended with an asthenic state of system, calling for supporting measures. The most effectual method of employing it, in these cases, is, very soon after the attack of the disease, to administer it freely at bedtime, in the form of hot infusion, the patient being well covered, so as to provoke copious and lasting perspiration; and if vomiting should take place the effect would be more certain. In the morning, the disease will often be found to have been arrested, or very much moderated; and afterwards the medicine may be given in small and repeated doses, so as not to nauseate. Dr. Chapman, in his Therapeutics (2d ed., i. 388), speaking of its employment in a species of influenza which had prevailed many years previously in the United States, and which, in consequence of the pain attending it, was commonly denominated *break-bone fever*, states that, from its prompt success in relieving this symptom, it acquired the popular name of *boneset*, by which it is still known. The probability is, that the epidemic alluded to by Dr. Chapman was that described by Dr. Rush as having occurred in Philadelphia, in the summer and autumn of 1780, called break-bone fever, from the violence of its pains, but which, there is every reason to suppose, was the disease since better known under the name of *dengue*. This fact would suggest a trial of eupatorium in that very painful epidemic disease.

In acute rheumatism, the medicine is said to have proved useful; and, in the atonic variety, occurring in feeble constitutions, without plethora, it might be very properly tried, with a view to its conjoined tonic and diaphoretic effects.

Though said to have been advantageously employed in obstinate cutaneous diseases, I have no faith whatever in its efficacy, except in so far as it may operate, like any other tonic, in promoting the general health. The same may be said of its remedial powers in dropsy, in which it has been recommended.

Administration. As an antiperiodic or tonic, the medicine may be given in powder, in doses of twenty or thirty grains, or more; but it is very little used in this form.

The *Infusion* (INFUSUM EUPATORII, *U. S.*) is a more eligible preparation. It is made in the proportion of an ounce to a pint of water, and given in the dose of one or two fluidounces, repeated more or less frequently, according to circumstances; three or four times a day, as a tonic, in chronic cases; and every hour, two, or three hours, as an antiperiodic, or joint tonic and diaphoretic, in those more acute. When its emetic effect is wanted, six or eight ounces of the hot infusion may be given at a draught.

A *watery extract* has been used in the dose of four or five grains.

Several other species of Eupatorium have been employed. Among our indigenous species, *E. purpureum*, or *gravel root*, has tonic and astringent properties, and is said to be diuretic. *E. teucrifolium*, or *wild horehound*, corresponds with the officinal species in properties, though less powerful; and *E. aromaticum* is considered, among the so-called eclectic physicians, as a valuable remedy in a number of diseases. The root of *E. Cannabinum* was formerly used in Europe as a purgative; and *E. Aya-pana*, of Brazil, resembles the boneset, but is weaker.

VI. SERPENTARIA. *U.S.*

SERPENTARIA. *U.S.*, *Br.*—Syn. *Virginia Snakeroot.*

Origin. This consists of the roots of *Aristolochia Serpentaria*, *Aristolochia reticulata*, and probably several other analogous species of the same genus, all of them small, indigenous, herbaceous perennials, growing in the woods in the Middle, Southern, and Western States; A. Serpentaria abounding in western Pennsylvania, Virginia, Ohio, Kentucky, etc.; A. reticulata in Louisiana, Arkansas, and the neighbouring regions.

Sensible Properties. The root consists of a short, contorted, knotty head, with numerous long, slender fibres or rootlets proceeding from it, which are often more or less interlaced, as the medicine is found in the shops. The roots of A. reticulata are straighter, thicker, and less flexible than the others, and consequently much less interlaced. The colour is at first yellowish, but becomes brownish by time; the odour is strong, aromatic, and agreeable; the taste very bitter, aromatic, and somewhat camphorous. The root yields its sensible properties and medical virtues to water and alcohol.

Active Constituents. These are a peculiar bitter principle, and a peculiar volatile oil, which may be separated by distillation.

Adulterations. Occasionally the roots of *Spigelia Marilandica*, and ung roots of *Polygala Senega*, are mixed with serpentaria, but y not by design. They are distinguishable by the total want of ur and taste of the genuine root.

Effects on the System. Serpentaria is a stimulating, diaphoretic tonic; ing its tonic properties, which are probably identical with those of the simple bitters, to its bitter principle, and its stimulant and diaphoretic influence mainly to its volatile oil. Taken internally, it sharpens the appetite, hastens the digestive process, increases the frequency of pulse and warmth of skin, and occasions, not unfrequently, either diaphoresis or diuresis; being disposed to produce the former effect, if given in warm infusion while the patient is well covered in bed, and the latter, if in powder, or cold infusion, while he is walking about and exposed to the air. When taken in over-doses, it may produce nausea, griping pain in the bowels, even vomiting or tenesmus, and will sometimes cause pain or a sense of weight in the head, with disturbed sleep.

Therapeutic Application. Virginia snakeroot has been known as a medicine from an early period of the settlement of this country. Like others of our valuable indigenous remedies, it originally attracted notice as an antidote to the bite of serpents; and, as such, is alluded to in a work by Dr. J. Cornutus, published at Paris in 1635 (W. P. C. Barton, *Veg. Mat. Med. of the U. S.*, ii. 48); but the first known mention of it was by Thomas Johnson, an apothecary of London, in an edition of Gerarde's Herbal, published in 1633 (Pereira, *Mat. Med.*, ii. 1299). Its supposed efficacy in the poison of serpents led naturally to its use in low and malignant febrile diseases, in which the blood was believed to be poisoned; and, by an easy transition, it came to be employed in other fevers, in which this malignant type was not presented. Sydenham recommended it in vernal intermittents (*Sydenham's Works*, edited by Dr. Rush, p. 460); and it is favourably spoken of by many of the medical writers of the last century. Its real value is now probably better known than formerly. It is simply tonic and stimulant to the circulation, with a tendency to produce perspiration, generally acceptable to the stomach in moderate doses, and probably without special influence on the brain or nervous system.

It may be employed in *pure dyspepsia*, attended with a degree of debility calling for something more stimulating than the simple bitters, and especially where there is a disposition to dryness of the surface; but its most appropriate application continues to be that for which it was early recommended, to the treatment, namely, of *fevers of a low or typhoid character*, or disposed to take on that character. Whenever any febrile disease begins to exhibit this tendency, and stimulation is demanded, serpentaria is one of the first medicines to which we may have recourse, provided the stomach be wholly free from inflammation, or vascular irritation. It may be used, therefore, with the condition of stomach mentioned, in typhus or typhoid fever when passing from the first stage of excitement into that of debility, in protracted remittent fever assuming a low character, in typhoid pneumonia, and in smallpox, scarlatina, malignant sore-throat, and erysipelas, under similar circumstances. But it should be understood that, in none of these affections, does it possess any specific curative powers, that it can act merely as a tonic and gentle stimulant, and that it should be used only as an adjuvant in very serious cases, being alone wholly incompetent to the support of the system under powerful depressing influences. In many of these cases, it may be very properly associated with Peruvian bark or quinia.

From my own observation, I should infer that serpentaria possesses no peculiar antiperiodic power, and that it cannot, therefore, be relied on for breaking the course of an intermittent or remittent fever; but in either, it may be conjoined with sulphate of quinia when the system is feeble, and the stomach somewhat insusceptible. The association of serpentaria with Peruvian bark has long been a habit among practitioners. It exists in the *compound tincture of Peruvian bark* of the British and American Pharmacopœias, better known under the name of *Huxham's tincture of bark.*

Dr. Chapman says of serpentaria "that it is admirably suited to check vomiting, and to tranquilize the stomach, especially in bilious cases." (*Elem. of Therap.*, etc., 2d ed., ii. 434.)

Administration. The medicine is sometimes, but rarely, given in *powder.* The *Infusion* (INFUSUM SERPENTARIÆ, *U. S.*), made in the proportion of *half an ounce* to a *pint* of boiling water, is the preparation ordinarily used. In the present Pharmacopœia the infusion, though prepared also in this way, is preferably made by percolation with cold water, essentially the same proportions being used. There is an officinal *Tincture* (TINCTURA SERPENTARIÆ, *U. S.*), which is rendered turbid by water.

The dose of the *powder* is from ten to thirty grains; that of the *infusion*, one or two fluidounces, to be repeated three or four times a day in chronic cases, every hour, two, or three hours, in acute. Of the *tincture*, which is employed chiefly as a stimulant and stomachic addition to other medicines, the dose is one or two fluidrachms.

A *Fluid Extract* (EXTRACTUM SERPENTARIÆ FLUIDUM, *U. S.*) is directed in the present Pharmacopœia, and is a good preparation, containing all the virtues of the root in a very small space. It is, indeed, a concentrated tincture; but the proportion of alcohol is almost insignificant, and, in view of the stimulant effect the fluid extract is intended to produce, wholly so. The dose is twenty or thirty minims, to be frequently repeated.

ARNICA. *U. S., Br.*

On comparing arnica with other medicines, I find none to which it appears to me to approach more closely than serpentaria; though it must be acknowledged that there is considerable difference between them. I have accordingly concluded to give it this subordinate position to serpentaria provisionally, until a better place can be found for it in the classification.

The name of arnica is given, in the U. S. Pharmacopœia, to the flowers, in the British to the root of *Arnica montana* or *Leopard's-bane.*

a perennial herbaceous plant, growing in the mountainous regions of Europe and Siberia, and, according to Nuttall, in the North-western parts of this continent. The entire plant has, when fresh, a strong disagreeable odour, which diminishes in drying, and an acrid, bitter, lasting taste. The flowers are most used in this country. Among other ingredients they were found by MM. Chevallier and Lassaigne to contain a peculiar principle, analogous if not identical with *cytisin*, previously discovered in the laburnum-tree. This is a powerful agent, acting energetically in the dose of five grains as an emeto-cathartic, and probably capable in excessive doses of producing poisonous effects. It is no doubt one of the active ingredients of the flowers; but certainly not the only one; as, besides a small proportion of volatile oil and acrid resin, a peculiar alkaloid has been obtained from them, which is not without influence upon the system. Our information, however, as to the relation between these two substances, the cytisin and *arnicina* (or preferably *arnicia*) as the alkaloid has been named, and as to the effects of both on the system, is yet too indefinite to admit of positive conclusions. It seems certain, however, that they are not identical; for, according to its discoverers, cytisin is readily dissolved by water, with difficulty by strong alcohol, and not at all by ether; while arnicia is but slightly soluble in water, and freely soluble in alcohol and ether. The root probably has essentially the same virtues as the flowers.

As a medicine, arnica has long been used on the continent of Europe, particularly in Germany, where it is highly esteemed. In the United States, it was almost unknown as a remedy until of late; but within a few years it has risen greatly in reputation, probably in part through the many German practitioners who are pursuing their profession in this country. So decided is the change in this respect that, in the present edition of the U. S. Pharmacopœia, it takes a place in the primary catalogue, having been transferred from the secondary, where it previously held a somewhat doubtful place. Arnica appears to be a general stimulant and tonic, analogous in this respect to serpentaria, but directed especially to the nervous system, and acting as a diaphoretic, diuretic, and emmenagogue. It is apt to nauseate, and in large doses operates as an emetic and cathartic. Very freely taken, it causes burning in the stomach, violent abdominal pain, excessive headache, muscular spasms, and other evidence of nervous disturbance. It is no doubt capable of acting as a poison. A case is recorded in the *London Lancet* (Nov. 18, 1864, p. 571), in which the patient was apparently saved only by the use of remedies from threatened death, consequent on the swallowing by mistake of an ounce of tincture of arnica. When first seen by the physician, he was in a state of approaching collapse, with sunken and glassy eyes, dilated pupils unaffected by light, voice low and muttering, pulse over a hundred, feeble and fluttering, great pain in the epigastrium, and a cold, dry skin. Intelligence, however, was not lost; and, from his account of himself, it appeared that little effect had been experienced for the first eight hours after the swallowing of the poison, except dryness of the mouth, that at the end of that time he was awakened from sleep by violent pain in the stomach, and that on rising he felt sick and feeble. The treatment consisted in the exhibition of an ounce of brandy and twenty minims of laudanum, which were repeated in two hours, and the external application of heat. He gradually recovered. An emetic would have been the appropriate remedy at an earlier stage, but was out of the question under the circumstances of the present case.

Arnica appears to be adapted to febrile diseases with a low or typhoid tendency, also to various phlegmasiæ offering a similar condition. It has been used in rheumatism and gout, diarrhœa and dysentery, chronic catarrh and nephritis, passive hemorrhage, dropsy, and amenorrhœa, and certain paralytic affections, especially amaurosis. Having been found useful in the nervous disturbance following accidents of various kinds, it got a reputation as a special cure for wounds, sprains, bruises, and the swellings consequent on dislocation, and is much employed in domestic practice as a local application in these affections, for which the tincture is deemed especially useful. The powder is sometimes used to excite sneezing.

Arnica may be given in powder or infusion; the dose of the former being from five to twenty grains; of the latter, made in the proportion of an ounce to the pint, half a fluidounce to a fluidounce every two hours.

A *Tincture of the Flowers* (TINCTURA ARNICÆ, *U. S.*) and a *Tincture of the Root* (TINCTURA ARNICÆ, *Br.*) are officinal, the former in the U. S., the latter in the Br. Pharmacopœia. It is this preparation either undiluted, or mixed with water or soap liniment, that is so much used in the local affections above referred to. From some observations made by Dr. Garrod, of London, there is reason to believe that the effects of the tincture in these cases is little more than that of the alcoholic menstruum. The dose for internal use is from thirty minims to two fluidrachms.

An *Extract* (EXTRACTUM ARNICÆ ALCOHOLICUM, *U. S.*) is prepared from the flowers by percolation with alcohol and subsequent evaporation. The dose is from five to ten grains. But is more used in the preparation of the plaster than for any other purpose.

The *Plaster of Arnica* (EMPLASTRUM ARNICÆ, *U. S.*) is made by incorporating the extract with the melted resin plaster. This is another preparation very popular, outside of the profession, as a remedy for sprains, bruises, etc.

VII. MYRRH.

MYRRHA. *U. S.*, *Br.*

Origin. Myrrh is a concrete exudation from *Balsamodendron Myrrha*, a shrub or small tree, growing in the deserts of Arabia and North-eastern Africa. Two commercial varieties were formerly brought into market, one from the ports of Egypt in the Mediterranean, the other from the ports of India; both, however, being originally obtained from the same neighbourhood. They were distinguished by the names of Turkey and India myrrh. The former was much purer and finer than the latter, because selected with greater care, in reference to its more expensive carriage. At present both kinds are imported from India, whither they are taken by Arab vessels from the Red Sea.

Sensible Properties. Myrrh is in small fragments, irregular or rounded, like tears, or in larger masses, as if consisting of the smaller agglutinated together. The best specimens, formerly called Turkey myrrh, are of a pale reddish-yellow, or reddish-brown colour, often powdery on the surface, and translucent. The larger agglutinated pieces exhibit various shades of colour. The inferior kinds, formerly known as India myrrh, are in very irregular lumps, of a dark colour, opaque, and full of impurities. Myrrh is brittle, with a shining fracture. The powder of the best kinds is whitish or yellowish-white, of the inferior darker, with a somewhat reddish hue. It is not fusible by heat, but is inflammable. The odour is strong, peculiar, and fragrant; the taste bitter, somewhat acrid or pungent, and aromatic.

Composition, and Relation to Solvents. The active principles of myrrh are a *peculiar bitter resin*, which has been called *myrrhin*, and a *volatile oil.* In composition it is a gum-resin, containing volatile oil, and other ingredients of little or no practical importance. Water dissolves the gum and a very small proportion of the volatile oil; alcohol the resin and the whole of the oil; and, as these two are the active principles, alcohol would seem to be the best menstruum. But when the gum-resin is rubbed with water, it readily forms a white or yellowish-white opaque emulsion, in which the resin and oil are held in suspension by the gummy matter dissolved in the water; and, though a portion of the resin soon subsides, the mixture is sufficiently permanent, or so easily rendered uniform by shaking, that this form is usually preferred for the administration of the medicine. Alkalies unite with the resin, and render it much more soluble in water; so that, by the addition of a portion of an alkaline carbonate in forming the emulsion, this is rendered of easier preparation, and more permanent. The volatile oil may be separated from the gum-resin by distillation.

Effects on the System. Myrrh acts on the system probably as a simple bitter tonic through its resin, and as a stimulant to the circulation through its volatile oil. It has no special influence on the brain or nervous system generally; but is supposed to have a peculiar tendency to the lungs and uterus, stimulating their functions respectively, and consequently acting as an expectorant and emmenagogue. When swallowed in small doses, it increases the appetite, produces a feeling of warmth in the stomach, and invigorates digestion, as well probably as the vital functions generally. In larger quantities, it increases the pulse, produces a glow over the system, and operates generally as a mild arterial stimulant. In over-doses, it irritates, or may even inflame the stomach, and gives rise to general febrile phenomena.

Therapeutic Application. Myrrh has been known as a medicine from the earliest records of our science. It is now probably less esteemed than formerly, but is still much employed, and is not without valuable powers. As a tonic simply, it is not often used; being too stimulating, and too apt to irritate the stomach, if this be at all disposed to be so affected, or to augment any existing irritation or inflammation. But in a perfectly sound, though weakened state of the stomach, with a languid condition of the functions generally, it may be given advantageously; and especially when, with this debilitated state of the system, there coexists either amenorrhœa, or a chronic bronchial inflammation, with profuse expectoration, or both these conditions jointly. The particular affections, therefore, to which it is best adapted, are chlorosis in females with amenorrhœa, and chronic bronchitis in the old or debilitated, with or without hectic fever, but with copious and especially puruloid expectoration; and, when these affections are associated, the indications for its use are still stronger. But particular care must be taken that the stomach is in no degree phlogosed when it is administered. It has been much used in phthisis; but I cannot say that I have known it to be of material service in that complaint; while it has often done harm by disturbing the stomach. It is seldom given alone. In anemic states of the system with amenorrhœa, it is often combined with one of the preparations of iron, and, if there be constipation at the same time, or a tendency to it, with aloes or rhubarb.

Being a local stimulant, myrrh has been much used externally in foul, flabby, or indolent ulcers, as a mouth-wash in spongy or ulcerated gums, and as a gargle in ulcerous affections of the fauces. For these purposes, the powder is, in external ulcers, simply sprinkled on the diseased surface, or applied in the form of an ointment; in affections of the mouth and fauces, it is employed rubbed up with water.

Administration. Myrrh may be administered in powder, pill, or emulsion, in the dose of from ten to thirty grains. In the simple form of *powder*, it is little used.

Nor is it often given, uncombined, in the form of *pill;* but it enters into several officinal combinations in this form. Such are the *Pilulæ Aloës et Myrrhæ,* formerly called *Rufus's pills, Pilulæ Ferri Comp., Pil. Galbani Comp.,* and *Pil. Rhei Comp.,* of the U. S. Pharmacopœia. To these the reader is referred, under the heads of their prominent ingredients respectively.

Emulsion is the form of administration most frequently used. It should be made by selecting the finest pieces, powdering them, and rubbing the powder up thoroughly with such a proportion of water, that a tablespoonful of the mixture shall contain the dose of the gum-resin which it may be desired to exhibit. If an alkaline carbonate be indicated at the same time, its addition will tend to facilitate the preparation. The noted *anti-hectic mixture* of Dr. Griffiths, formerly very popular, and still considerably used in chlorosis, amenorrhœa, hysteria, and the hectic fever of pulmonary complaints, is made of these ingredients, with the addition of sulphate of iron, which is converted into the carbonate through reaction with the carbonate of potassa used. The *Mistura Ferri Composita* of the Pharmacopœias is an imitation of this preparation.

Decoction is not an appropriate mode of preparing myrrh, as the whole of its active properties are not extracted by water. The gum-resin, however, is an ingredient in the *Compound Decoction of Aloes* of the British Pharmacopœia, in which the resin is dissolved by means of the alkaline carbonate used.

Tincture of Myrrh (TINCTURA MYRRHÆ, *U. S.*), though little used internally, is often employed locally as a stimulant to indolent and foul ulcers, to promote the exfoliation of bones, and, diluted with water, as a mouth-wash or gargle, in spongy gums, aphthous sore mouth, and ulceration of the mouth and fauces. When mixed with water, it becomes turbid by the separation of the resin. The dose is from thirty minims to a fluidrachm.

◆

There are several other stimulant tonics, which owe their virtues to bitter principles and volatile oils, but having little to recommend them in preference to those in more general use, and not being at present much employed, will be more appropriately considered in a subordinate position. Such are *angustura, cascarilla, contrayerva, wormwood, tansy,* and *horehound.* A brief notice will suffice for each of these.

1. ANGUSTURA BARK.—ANGUSTURA. *U. S.*—CUSPARIA. *Br.*

This is the bark of the *Galipea officinalis* of Hancock, a small tree growing in the interior of South America, on the banks of the Orinoco. It is taken first to the town of Angustura upon the Orinoco, and thence to the West Indies, whence it enters into general commerce.

Properties. It is in pieces of various length, usually short, slightly rolled or nearly flat, thin, with edges pared obliquely, externally covered with a soft, yellowish-gray or whitish epidermis, internally yellowish, and when pulverized yielding a pale-yellow powder. It has a peculiar odour becoming fainter with age, and a bitter, slightly aromatic, and adhesive taste, leaving a sense of pungency on the end of the tongue.

Active Constituents. These appear to be a peculiar bitter principle soluble in water and alcohol, called *angusturin* or *cusparin*, a *hard bitter resin*, a *soft acrid resin*, and a *volatile oil;* but it may be questioned whether the bitter resin referred to may not owe its taste to an unseparated portion of the proper bitter principle. The soft resin is probably the oxidized volatile oil.

Medical Properties and Uses. Angustura was employed by the aborigines, who appear to have made it known to the early settlers. From the continent it passed to the West Indies; and was not introduced into Europe till about ninety years since. Its effects on the system are those of a stimulant tonic, in small doses acceptable to the stomach, but in larger apt to vomit and purge. Its tonic property depends probably on the bitter principle, the stimulant on the volatile oil. It has no special influence on the brain or nervous system. In South America and the West Indies, it has been used as a substitute for cinchona in intermittent and remittent fevers, and is said to have proved very efficacious in the malignant bilious fevers of those latitudes. Experience in Europe and this country has not proved favourable to its claims as an antiperiodic, and it probably possesses no peculiar property of this kind. Though it has succeeded in arresting some slight cases of ague and fever, which almost anything capable of impressing the system at all will occasionally do, yet in the more obstinate kinds it has failed, and can be certainly relied upon in none. Another application made of it has been to the treatment of bilious diarrhœa and dysentery, as they occur in tropical countries; and it may have been useful as a tonic and stimulant in some of those cases: but, in the diseases as they occur with us, it would in general probably do more harm than good. It is little used in this country.

Administration. It may be given in powder, in the dose of from ten to thirty grains. The *Infusion* (INFUSUM ANGUSTURÆ, *U. S.*) is, however, preferred. It is made by macerating half an ounce with a pint of boiling water; or, in essentially the same proportions, by percolation with cold water; and given in the dose of two fluidounces, three or four times a day. The *Tincture* is no longer officinal. The dose of it, as formerly prepared, was one or two fluidrachms.

FALSE ANGUSTURA BARK. Under this name, a bark, now believed to be the product of Strychnos Nux Vomica, has sometimes been sold for genuine Angustura bark, with fatal consequences. This could happen only before attention had been called to the subject. Such a mistake would be unpardonable now; for there is little real resemblance between the two barks, and it is only necessary that the slightest caution should be observed. In this country, I do not think that the substitution has ever taken place. I have never seen false Angustura bark in the United States, except parcels which have been sent hither as specimens. It is not used in medicine, but, containing a large proportion of brucia, and probably also strychnia, it might be employed for the extraction of those principles.

2. CASCARILLA. *U. S.*, *Br.*

Cascarilla is the bark of Croton Eleuteria, a small West India shrub, inhabiting especially the Bahamas, and abundant in the little island of Eleuteria, from which it derived its name.

Properties. It is in small quills or pieces of quills, from three or four inches long and half an inch in diameter, down to the smallest fragment. Sometimes it is in pieces curved longitudinally, and appearing as if shaved from the stem, having now and then portions of the wood attached to their inner surface. Externally the bark is invested with a whitish or grayish-white epidermis, which, however, is sometimes wanting, in which case the surface of the proper bark presents a dark-brown colour. The inner surface is of a chocolate colour, and the fracture, which is short and abrupt, is reddish-brown. The odour is agreeably aromatic, and increased by friction; the taste, warm, spicy, and bitter. When burnt, the bark emits an odour, resembling that of musk, though not so strong, and more agreeable. On this account, it is used for fumigation; and smokers sometimes add it to their tobacco. It yields its virtues to water or alcohol, but more completely, it is said, to a mixture of the two.

Active Constituents. These are a peculiar bitter principle, called *cascarillin*, and a volatile oil, which is abundant, and may be obtained by distillation.

Medical Properties and Uses. The first account of the use of cascarilla dates as far back as about the year 1690. It was for a time a very popular remedy in Europe, having been seized upon, as a substitute for bark, by many who were prejudiced against that medicine; and its febrifuge virtues were for some time in high esteem. It came, however, at length to be estimated at its true value; and at present is considered nothing more than a mild aromatic tonic, usually acceptable to the stomach, and, in consequence of the predominance of its aromatic properties, deserving perhaps better to rank in that division of the tonics, than among the bitters. When smoked in connection with tobacco, it is said to have induced vertigo and intoxication; but, admitting this effect, which, however, is doubtful, it must be ascribed, not to the cascarilla itself, but to its empyreumatic product. The strong resemblance of its odour, when burned, to that of musk, would justify an attempt to collect the volatile products resulting from its combustion, and to ascertain whether they might not also imitate that powerful antispasmodic in its effects on the system.

The bark is used chiefly in debilitated states of the stomach and bowels, as in dyspepsia, flatulence, and diarrhœa and dysentery connected with weakness or relaxation of the bowels, or in the convalescence from these affections. It is a good addition to more powerful tonics.

M. Follemberg, a European veterinary surgeon, has found cascarilla to exercise a powerful influence, in the lower animals, in promoting a flow of milk after the birth of their first young. He gives to a mare, in twenty-four hours, about two ounces of the powder incorporated with meal. In greatly reduced doses, it may possibly prove equally useful in the puerperal woman whose milk is retained. (*Ann. de Thérap.*, A.D. 1863, p. 84.)

The dose of the powder is from ten to thirty grains. The *Infusion* (INFUSUM CASCARILLÆ, *U. S.*) is made by macerating an ounce of the coarsely powdered root in a pint of boiling water, or by percolation in similar proportions with cold water; and is given in doses of two fluidounces, repeated as customary with tonic medicines. A *Tincture* (TINCTURA CASCARILLÆ, *Br.*) is directed by the British Pharmacopœia, and may be added to stomachic or purgative infusions in the quantity of one or two fluidrachms.

3. CONTRAYERVA. *U. S.* 1850.

Contrayerva has been omitted in the present Pharmacopœia. It is the root or rhizome of *Dorstenia Contrayerva*, a small perennial plant, growing in the West Indies, Mexico, and Peru. As in the shops, it is of a somewhat oblong shape, an inch or two in length, rough, very hard, reddish-brown externally, pale internally, and furnished with numerous long, slender, yellowish radicles, attached to the lower part. The odour is aromatic; the taste warm, pungent, and bitter. Boiling water or alcohol extracts its virtues, which probably depend on a volatile oil, and a bitter principle, though the latter has not been isolated.

In its effects on the system, it is gently tonic, aromatic, stimulant, and diaphoretic, bearing some resemblance to serpentaria, but less powerful as a tonic. It was formerly used in low febrile diseases disposed to assume a typhous or malignant character, in dysentery and diarrhœa with debility, and in other conditions supposed to call for stimulation; but it has given place to more convenient or efficient remedies, and is now scarcely used. The dose of the powder is from twenty to thirty grains. An infusion, made in the proportion of an ounce of the bruised root to a pint of boiling water, may be given in doses of one or two fluidounces.

4. WORMWOOD.—ABSINTHIUM. *U. S.*

Wormwood, as a medicine, consists of the leaves and flowering tops of *Artemisia Absinthium*, the common wormwood of our gardens, but a native of Europe. It has a strong, peculiar odour, and an extremely bitter, disagreeable, nauseous taste. These properties, as well as its medical virtues, it imparts to water and alcohol. They reside chiefly, if not exclusively, in a bitter principle called *absinthin*, and a peculiar *volatile oil*, which, when separated by distillation with water, has a deep-green, brown, or yellowish colour, an acrid, bitter taste, and a strong odour of the plant. The herb may contain a little *tannic acid*, but not enough sensibly to modify its effects.

Wormwood is a stimulating tonic, resembling chamomile in its effects, but stronger and more disagreeable. In small doses, it operates like the simple bitters; in larger, excites the pulse, increases the heat of the skin, produces headache, and is said sometimes to have exhibited narcotic effects. Its active principles are no doubt absorbed, as it renders the flesh and milk of animals fed with it bitter. In very large doses it is apt to vomit. It is among the medicines used by the ancients, and, before the discovery of Peruvian bark, was much relied on in the treatment of intermittents. Though greatly inferior in antiperiodic power to cinchona, it has some efficacy in arresting intermittent fevers, and is particularly recommended as a preventive. It has been used also as an anthelmintic and emmenagogue, and probably has some efficiency in these respects. It is probably not without a stimulant influence over the nervous system, such as characterizes the antispasmodics, or nervous stimulants of the classification adopted in this work; and hence may be used, with hope of benefit, in hysterical cases attended with feeble digestion, and defective menstruation.

The dose of the *powder* is one or two scruples; that of the *infusion*, made in the proportion of an ounce to the pint, is two fluidounces. The herb has been used externally with hot water as a fomentation, but probably with little other benefit than such as may be ascribed to the heat and moisture.

A cordial is much used in France under the name of *absinthe*. It is said to be prepared by mixing about five drachms of the volatile oil of wormwood (*essence d'absinthe*) with 100 quarts of alcohol. It might be supposed that, in so small a proportion, the oil could produce no seriously injurious effects; but M. E. Descaine has satisfied himself that the cordial is much more marked in its effects, and much more injurious than the spirit contained in it can be; intoxication being more rapidly produced; the phenomena included under the name of alcoholism, both acute and chronic, more quickly developed; and the effects on the nervous system more marked, resembling those of the acrid narcotic poisons. (*Comptes Rendus*, Août, 1864.) In confirmation of the statements of M. Descaine, M. Marcé made various experiments with the lower animals, from the result of which it appears that the oil of wormwood is in large doses a violent narcotic poison. In the dog two or three grammes (30 to 45 grains) caused trembling, stupor, and insensibility; three or four grammes, epileptic convulsions, involuntary evacuations, foaming at the mouth, and stertor. But these symptoms were transient, and death did not result. (*Bullet. Gén. de Thérap.*, Mai 15, 1864.)

5. TANSY.—TANACETUM. *U. S.*

The tansy, or *Tanacetum vulgare*, is an herbaceous perennial, indigenous in Europe, but introduced into the United States, where it grows wild, and is cultivated in gardens. The whole herbaceous part is used. It has a strong, peculiar odour, which is much diminished by drying, and a warm, bitter, sub-acrid, aromatic taste. Its activity, which is imparted to water and alcohol, depends on a bitter ingredient, and a volatile oil. There is also a little tannic acid, but insufficient materially to influence the operation of the medicine. The oil is greenish-yellow, and has the characteristic odour of the plant.

Tansy has been known as a medicine for at least one thousand years. It is a stimulating tonic, and supposed also to possess anthelmintic and emmenagogue properties. In large quantities, it is probably somewhat narcotic; at least, so we may infer from the operation of the volatile oil. From its supposed possession of the power of causing abortion, this oil has been repeatedly taken in large doses; and three cases of death from it, in this country, have been recorded; one resulting from a single fluidrachm of the oil, a second from half a fluidounce, and the third from an ounce. The symptoms were violent convulsions, coma, and great prostration, which speedily ended in death. The fatal issue was too rapid to be owing to any irritant operation on the stomach, and in one case, which was examined after death, no inflammation was found.

The medicine has been given in dyspeptic affections, intermittent fever, to prevent the paroxysms of gout, in hysteria, amenorrhœa, and worms in the bowels. At present, its use is confined mainly to the two latter affections, and in these it is employed much more in popular than regular practice. The seeds are thought to be more powerful, as a vermifuge, than the oil.

The dose of the powder is from thirty grains to a drachm; that of an infusion, made with an ounce of the herb to a pint of water, two or three fluidounces, two or three times a day. A drop or two of the oil may be added to each dose of the infusion.

6. HOREHOUND.—MARRUBIUM. *U. S.*

Common horehound, or *Marrubium vulgare*, is a perennial herbaceous plant, a native of Europe, but introduced into the United States, where it grows abundantly along the roadsides. The whole herbaceous part is used. This has, when fresh, a strong, rather agreeable odour, which is diminished by drying, and lost by long keeping. The taste is bitter and lasting. The herb yields its sensible properties and medical virtues to water and alcohol. These depend on a bitter constituent and a volatile oil. It contains also a little tannic acid.

Horehound has been known as a medicine from the times of Charlemagne. In reference to its effects on the system, it is mildly tonic and gently stimulant, and is thought also to be somewhat diaphoretic, diuretic, and laxative. If we may judge of the opinion entertained of its action by the use made of it, we must add to the properties just mentioned those also of an expectorant. The complaints in which it has been given are dyspepsia, chronic hepatitis, jaundice, amenorrhœa, various cachectic affections, chronic bronchitis, pulmonary consumption, and ordinary catarrh. What good can be effected, in these and other complaints, from a mild tonic, which, when taken in warm infusion, may gently promote the cutaneous and bronchial secretions, and perhaps the uterine, may be expected from horehound, but nothing more. It is at present seldom used by regular practitioners, and, even as a domestic medicine, is chiefly employed in catarrhal affections of the air-passages. The dose of the powder is from thirty grains to a drachm. The infusion is made in the proportion of an ounce to a pint of hot water, and given in wineglassful doses. A syrup is often prepared from it, and a candy impregnated with its taste is sold in the shops; both being used for ordinary colds.

7. CATNEP.—CATARIA. *U. S.*

This well-known plant, sometimes called *catmint* (*Nepeta Cataria*), is a very old medicine, at present more employed in domestic than in regular practice. The whole herb is efficacious; but the leaves only are recognized in our Pharmacopœia. They have a strong peculiar odour, and a pungent, bitterish, somewhat aromatic taste; but both the smell and taste are disagreeable rather than otherwise. Their virtues, so far as known, depend on their peculiar volatile oil, tannic acid, and a bitter principle, which, however, has not been isolated. They impart their virtues to water and alcohol. In its effects on the system, catnep is a moderately stimulant tonic, with antispasmodic and emmenagogue properties. In cats it is said to act as an aphrodisiac. Certainly these animals exhibit a great fondness for it; and it owes its name to this cause. It is generally used in the form of infusion, which may be made in the proportion of an ounce to the pint, and given, in the dose of one or two fluidounces, in flatulent colic, amenorrhœa, and the different forms of hysteria. The fresh leaves are said to relieve toothache, if chewed, and kept for a few minutes in contact with the diseased tooth.

8. YARROW.—ACHILLEA. *U. S.*

This was introduced into the secondary catalogue of the U. S. Pharmacopœia at the recent revision. The whole herb is used. It is the product of *Achillea Millefolium*, often called *milfoil*, from the great number and minuteness of the divisions of the leaves. Though a native of Europe, it is now abundant in this country, in which it has become completely naturalized. The herb has a feeble though rather agreeable odour, which is retained after drying, and a bitterish, pungent, somewhat astringent taste. The aromatic properties are somewhat stronger in the flowers than the leaves. In the latter the astringency and tonic property predominate. The active principles are volatile oil, tannic acid, and a bitter substance which has not been isolated. There is also a peculiar acid, called the *achilleic;* but how far this possesses any therapeutic properties has not been ascertained. The volatile oil, separated by distillation, has a beautiful blue colour, and the odour of milfoil. The virtues are extracted by water and alcohol.

Yarrow is a mild aromatic tonic and astringent. It has been used in intermittent fever, flatulent colic, and hysterical disorders. M. Richard, of Soissons, in France, finds it efficacious in low conditions of the exanthematous fevers with imperfect eruption, in colic, infantile convulsions and dysmenorrhœa, using it at the same time as a drink in the form of infusion, as an injection in the same form, and in fomentation. Dr. B. H. Coates, of Philadelphia, confirms the old opinion as to its efficiency in hemorrhages. (*Trans. of College of Phys. of Philadelphia*, N. S., ii. 334.) Dr. Joly, of France, considers it an excellent emmenagogue, and has obtained advantageous results from it in suppression of the lochia. (*Bullet. Gén. de Thérap.*, Mars, 1857.) The most convenient form of administration is that of infusion, which may be made in the proportion of an ounce to the pint, and given in the dose of a wineglassful. The dose of the volatile oil is twenty drops.

* * *

3. *Aromatics.*

This subdivision of medicines is characterized by an agreeable odour and taste, dependent on the presence of volatile oil. They do not correspond exactly with the tonics, being more excitant, though less so than the class of circulatory stimulants. They do not equal the bitter tonics in the property of promoting the digestive and nutritive functions. Their action, moreover, is more speedy, and less durable. Yet they approach more closely to these medicines than to any other division in the classification I have adopted, and are often used, in conjunction with tonics, to increase their stimulant influence, or in other ways modify their action. I have, therefore, thought it best to follow the example of Dr. J. Murray, of Edinburgh, in his excellent system of Materia Medica, in arranging them in the position they here hold; guarding the student, however, against the mistake of supposing them identical, or even very analogous, in their operation, with the bitters.

Effects on the System. When taken internally, the aromatics occasion generally an agreeable feeling of warmth in the stomach, moderately increase the frequency of pulse and heat of the surface, and often diffuse a pleasant glow over the system, without exhibiting any special tendency towards the brain or nervous system generally, or any particular influence over the secretions. They resemble, in their direction to the circulatory function, the medicines hereafter to be described under the name of arterial stimulants; but they differ, in being much more powerful, relatively, in their local than their general excitant effect. Thus, to whatever surface they are directly applied, whether the skin, the mouth and fauces, or the mucous membrane of the stomach, they stimulate actively the blood-vessels of the part, and, largely used, cause high vascular irritation, or even inflammation; while upon the heart and general circulation they produce little greater effect than might be ascribed to sympathy with the local excitement. This disproportion in their local stimulation may be ascribed to the difficult absorption of the volatile oils, to which they owe their powers. There is a great difference in the absorbability of the different volatile oils. Some, as those of turpentine, copaiba, garlic, etc., enter the circulation with great facility, and hence display considerable energy in their action upon the system generally, or on organs remote from the point of their application. The aromatic oils, as those of cinnamon, cloves, ginger, peppermint, etc., have, in general, much less of this facility; and, though they may act locally with equal power, are much less diffusible in their effects.

In their operation specially upon the stomach and other portions of the alimentary canal, they do not so much invigorate the particular function of digestion, as produce a general vascular excitement of the parts, attended with a comfortable or pleasurable sensation, comparable to that of a genial glow on the surface of the body. In the accompanying plentiful, but not excessive supply of blood, which is the proper material for all the functions, that of the stomach is in a state to respond to its special stimulants; and tonics, therefore, will often operate with greater energy, in connection with aromatics, than when administered alone. The muscular tissue, too, without being stimulated, as by purgatives, to an increase of its regular peristaltic action, is yet put into a condition of greater power, and will contract with increased energy under the special stimulus of distension, or with a better regulated movement under that of cathartic medicine. Upon these principles may be explained all the peculiar therapeutic uses of the aromatics.

Therapeutic Application. They are much used as cordial stimulants to the stomach and bowels, in debility of these organs; and have the great advantage over the more diffusible stimulants, such as alcohol in its different forms, that their operation is limited mainly to the part. Given in connection with food, particularly with such as may be of difficult digestion, they favour its solution in the stomach, by enabling this organ both to secrete the solvent juice more vigorously, and the muscular coat of the stomach to perform its office more efficiently, under the stimulus of the nutriment. Hence their use as condiments in all times, and in all parts of the world.

They are given also to relieve nervous uneasiness and spasmodic pain of the stomach, to aid in the expulsion of flatus, and to correct nausea. All these offices they perform upon the principle above stated. The nervous tissue, duly supplied with blood, is relieved of those irregular sensations and actions to which it is so liable when debilitated, and can better resist the disturbing influence of substances calculated to produce nausea or griping pain. The muscular coat, in the same state of its supply, feels duly the presence of the distending flatus, which it now expels by a vigorous contraction, instead of being thrown by it into those irregular and vain contractions called spasms. In reference to this operation of aromatics, they are called *carminatives*, a word handed down from the ancients, who were familiar with this effect, but could not so satisfactorily explain it, and therefore referred it to the mysterious influence of charms, and believed it to be much promoted by singing verses (*carmina*), during the administration of the medicine.

To sum up, in a few words, the therapeutic applications of aromatics; they are used to relieve the nervous pains, spasms, disordered sensations, and languor of stomach, attendant on dyspepsia or other debilitated states of the organ; to correct flatulence and pains arising from it, whether in the stomach or bowels; as anti-emetics to obviate nausea or gastric irritability when purely nervous; and, lastly, to aid or correct the operation of other medicines, or facilitate their administration by concealing or modifying their disagreeable taste.

They are given with *substances disposed to nauseate*, whether by their taste, or their direct influence on the stomach, in order to obviate this effect.

With *cathartics* they are very often exhibited, not only in reference to the influence just mentioned, but also to correct or obviate their griping tendency.

With *tonics* they are habitually administered, to cover their taste, to render them more acceptable to the stomach, to give them greater efficiency in the promotion of digestion, and to increase their stimulant effect, when such an increase is indicated.

They are *contraindicated* by existing vascular irritation or inflammation of the stomach, and by any considerable febrile excitement, in a sthenic state of the system.

In very large quantities, some of them, and all in the concentrated form of their volatile oil, are capable of inducing inflammation of the stomach, and thus proving dangerous if not fatal.

When abused as condiments, they may cause the following evil effects. In the *first place,* they may give rise to chronic inflammation of the stomach, by sustaining a constant vascular irritation of that organ; *secondly,* they may debilitate the stomach by wearing out its excitability through over-excitement; and *thirdly,* by increasing the amount of food digested, they may lead to an excess in the supply of blood, a consequent plethoric state of system, and, in conjunction with other influences, to the generation of a gouty diathesis.

They are not unfrequently used externally, either alone, or in conjunction with other medicines, as irritants to the skin, or rubefacients. (See *Rubefacients.*)

As they depend mainly for their efficiency upon the *volatile oils* they contain, these are often separated by distillation with water, and very advantageously used as substitutes for the aromatics themselves. Their effects are the same; but they require to be administered with more caution, as they are more liable to produce serious effects, if taken in over-doses. As to the modes of preparing the aromatic volatile oils, their chemical composition and reactions, the tests of their purity, and the general rules regulating their pharmaceutical management, the reader is referred to the U. S. Dispensatory.

Administration. The aromatics may be given in *substance,* or in the forms of *infusion, tincture, fluid extract,* and *volatile oil.* The form of infusion is much used, and generally very suitable; but it should be remembered that water will dissolve but a small proportion of volatile oil, and, in the case of those particular aromatics which depend for their influence exclusively on the oil, the proportion of the medicine to the menstruum should be small, to avoid waste. *Decoction* and *dry extract* are inappropriate forms; as the volatile oil on which their virtues depend is more or less driven off during their preparation. In the *fluid extract,* if properly made, the oil may be retained; and this is often a very convenient form for use. *Tincture* is a very appropriate form, whenever the necessary amount of alcohol, used in the preparation, may not be objectionable.

The *aromatic oils* are frequently preferred, in consequence of their less bulk, their greater power, and their greater convenience of administration. Some of them may be given undiluted, simply dropped on sugar; but most of them are too pungent and powerful to be exhibited in that way. They are, however, often and very conveniently exhibited by dropping them on sugar, and then mixing this thoroughly with water.

The sugar enables the water to hold the oil suspended sufficiently long for use.

A common method of exhibiting the oil is in alcoholic solution, in the shape of *spirits* or *essences*. The name *spirit*, in relation to the aromatic oils, was formerly used to designate preparations made by exposing a mixture of the aromatic and alcohol to distillation; the oil coming over dissolved in the alcohol. It is now also applied to similar preparations, made either by directly dissolving the oil in alcohol, or by distilling the oil and alcohol together. Such is the meaning of the term spirit as employed in the present U. S. Pharmacopœia, though it is extended so as to embrace spirituous solutions of aëriform or volatile substances in general. But, in former editions of the Pharmacopœia, to entitle an alcoholic solution of one of the volatile oils to the officinal title of spirit, it was required to be of a strength approaching that of the spirits made in the original method. The name of *essences* has been popularly appropriated to stronger solutions of the oil in alcohol; generally of such a strength as to permit the preparation to be taken on sugar without further dilution. These were designated in the Pharmacopœia of 1850 as *tinctures of the respective oils*. Thus, we had *tinctures of the oil of peppermint*, and *oil of spearmint;* but this nomenclature has been abandoned.

Another very common and useful form of exhibition is that of the *aromatic waters*. These were originally made by distilling water from the aromatic in substance; but this method of preparation has, in the United States, been almost entirely abandoned for the much more convenient method of simply dissolving the oil in water. When the oil and water are merely shaken together, they unite but sparingly, and the resulting solution is very feeble. But, by the intervention of some body which, without being itself soluble, may, by trituration with the oil, so divide its particles as to bring them into intimate contact with the particles of water, when the two are shaken or rubbed together, a considerable proportion of the oil is taken up; enough to give a decided odour and taste, and some medicinal activity to the solution. The substance preferred for this purpose is usually carbonate of magnesia; and the aromatic waters of our national standard are prepared in this way; care being always taken to separate the insoluble matter by filtration. The aromatic waters may sometimes be advantageously given with a view simply to the medicinal effect of the oil; but much more frequently they are used as menstrua or vehicles for other substances, the taste of which they cover, while they often render them more acceptable to the stomach.

I. ORANGE-PEEL.

1. BITTER ORANGE-PEEL. AURANTII AMARI CORTEX. *U. S.*—AURANTII CORTEX. *Br.*

2. SWEET ORANGE-PEEL. AURANTII DULCIS CORTEX. *U. S.*

Origin. This is the rind of the orange, of which there are two kinds, derived from different species or varieties of Citrus; the one, *Citrus vulgaris*, the bitter, or Seville Orange; the other, *Citrus Aurantium*, or common sweet orange. Both are natives of India and China, but cultivated generally in tropical latitudes.

Sensible and Chemical Properties. The rind consists of two parts, the outer, which is coloured, and the inner, white and spongy. In the former exclusively reside the virtues of the medicine; and sometimes it is only the outer coating that is kept in the shops.

The *bitter orange-peel,* which is imported into the United States, is generally, as found in the shops, in vertical slices, though sometimes in thin parings, as if cut off from the orange with a knife, like the paring of an apple. In the former, the white inner portion is retained, in the latter is wanting. The peel has an agreeable characteristic odour, and a bitter aromatic taste.

The *sweet orange-peel* is also in vertical slices, usually thinner than the other variety, with the same characteristic odour, and warm, aromatic taste, but without bitterness.

In both, there is a peculiar volatile oil, which resides in distinct cells in the rind, and may be obtained by pressure when the rind is fresh. In addition to this, there is, in the bitter orange-peel, a principle to which it owes its bitterness, but which has not been fully investigated. Water and alcohol extract all the virtues of the peel.

Kept in moist places, orange-peel is apt to spoil, in consequence of the attraction of the inner spongy portion for moisture. The parings keep better.

Medical Effects and Uses. Bitter orange-peel has the virtues of the aromatics combined with those of the simple bitters; the sweet variety is simply aromatic. Both are mild, and the tonic powers of the bitter are feeble. They are used almost exclusively in connection with other medicines, to render them less disagreeable to the taste, and more acceptable to the stomach. It is usually with tonics that they are associated, as with Peruvian bark, gentian, etc.; or with purgatives, as rhubarb. When with the former, the bitter variety should be preferred; when with the latter, the sweet.

Orange-peel is not altogether without danger if abused. I knew of a case in which death occurred, in an infant, from swallowing considerable quantities of the fresh rind. The child died with symptoms of obstruction of the bowels; and, on examination after death, the rind was found impacted in the intestines. But I am by no means certain that the oil contained in the rind may not have acted injuriously. In Buchner's *Neues Repertorium* (ii. 440–5) are given the results of numerous observations, by Dr. A. Imbert-Gourbeyre, of the effects of the *oil of bitter orange*, among which are mentioned headache, painful vision, buzzing in the ears, oppression of chest, loss of sleep, and phenomena similar to those of epileptic spasms. (*Cent. Blatt*, 15 Feb. 1854, s. 128.)

Administration. The peel is rarely given in substance. The dose of the *powder* might be from ten grains to a drachm.

The *infusion* is generally preferred. When used as an adjuvant or corrective of other medicines, the peel is most commonly employed in this form; half an ounce of it, well bruised, being added to a pint of the liquid. When the other ingredients are prepared in decoction, the peel should not be added till the end of the boiling. The British Pharmacopœia directs an *Infusion* (INFUSUM AURANTII, *Br.*), prepared with half an ounce of orange-peel, and an imperial half-pint or ten fluidounces of water. This may be used for the general purposes of the aromatics (see *page* 315), in wineglassful doses.

A *Tincture* (TINCTURA AURANTII, *Br.*) is directed by the British Pharmacopœia to be prepared from bitter orange-peel, and may be used to qualify the taste and action of various liquid preparations.

A *Syrup* (SYRUPUS AURANTII CORTICIS, *U. S.;* SYRUPUS AURANTII, *Br.*), prepared by the U. S. Pharmacopœia from the sweet peel, by the British from a tincture of the bitter, is a very grateful addition to other medicines. The U. S. preparation is much to be preferred.

A *Confection* (CONFECTIO AURANTII CORTICIS, *U. S.*) is prepared by separating the rind by a grater, and incorporating the coarse powder thus made with sugar. It is used chiefly as a vehicle for tonic and purgative medicines in powder.

An *Aromatic Water* (AURANTII FLORUM AQUA, *U. S.;* AURANTII AQUA, *Br.*), made by distilling water from the fresh flowers, is occasionally used as a perfume in the sick room.

◆

Other products of the genus Citrus are occasionally used in medicine for their aromatic properties. Among these are the following.

1. LEMON-PEEL.—LIMONIS CORTEX. *U. S.*, *Br.*

This is the rind of the lemon, which is the fruit of a variety of *Citrus medica*, a native of Asia, but now cultivated throughout the civilized world, either in the open air, or in conservatories. It has the same aromatic properties as orange-peel, though less agreeable, and is employed for the same purposes.

The *Volatile Oil of Lemons* (OLEUM LIMONIS, *U. S.*, *Br.*) is often obtained from the fresh rind, either by distillation or pressure; that procured in the latter method having more exactly the odour of the rind, though the former is more clear. It is used to impart an agreeable flavour to other medicines, for which purpose a drop or two may be added to a fluidounce of a liquid for internal use, and ten drops to an ounce of unctuous matter for outward application. It has been employed, undiluted, as a local application to the conjunctiva, in affections requiring stimulation; being pressed from the fresh peel directly into the eye. It produces, however, excessive pain, and should be used with caution.

A *Spirit of Lemons* (SPIRITUS LIMONIS, *U. S.*), prepared by the U. S. Pharmacopœia from lemon-peel, with the addition of the volatile oil of lemons, by maceration in alcohol, and a *Tincture* (TINCTURA LIMONIS, *Br.*), prepared in the same manner from the fresh peel, may be used as grateful additions to bitter and laxative infusions and mixtures.

2. OIL OF BERGAMOT.—OLEUM BERGAMII. *U. S.*—BERGAMOTÆ OLEUM. *Ed.*

This oil is obtained by expression, or distillation, from the fresh rind of the fruit of *Citrus Limetta*. It is employed chiefly, if not exclusively, for the sake of its very agreeable odour; being mixed with substances used as liniment or ointment, in the same manner as oil of lemons. It has been asserted, however, to be of itself very efficacious in the itch. (*Med. and Surg. Reporter*, Oct. 1, 1864, p. 112.)

◆

II. CINNAMON.

CINNAMOMUM. *U. S.*, *Br.*

Under the above name, the U. S. Pharmacopœia recognizes two products, the proper cinnamon gathered in Ceylon, and another kind brought from China, and known in commerce by the name of cassia. These may be conveniently distinguished, in reference to their commercial origin, as *Ceylon cinnamon* and *Chinese cinnamon*. It is the latter which is most commonly found in our shops, being brought to this country directly from Canton. The former is used only in small proportion, and generally comes to us by special order from England. It is the only variety recognized in the British Pharmacopœia. Cinnamon was known to the ancients.

Origin. Ceylon cinnamon is the prepared inner bark of *Cinnamomum Zeylanicum*, a tree growing wild in the East India island of Ceylon, where it is largely cultivated. The tree has been introduced into other tropical countries, and is cultivated to a considerable extent in the French province of Cayenne in South America. When the tree has attained a proper age, the stems are cut and decorticated; and the bark, deprived of its epidermis, is allowed to roll into quills, which are inserted one within another, so as to form a solid cylinder.

Chinese cinnamon or *cassia* is the inner bark of a species of Cinnamomum growing in China, which is believed to be the *C. aromaticum*, though certain knowledge upon this point is wanting.

Sensible Properties. Ceylon cinnamon is in cylindrical fasciculi, each consisting of a congeries of quills, inserted one into another, and, when unbroken, several feet in length; distinct fasciculi being neatly joined end to end, so as to appear as if of one piece. This variety is of a yellowish-brown colour, almost as thin as paper, smooth, somewhat shining, pliable, and of a splintery fracture. Its odour is very fragrant, and its taste warm, pungent, sweetish, slightly astringent, and exquisitely grateful.

The *Chinese* variety is in single tubes, of which the finest differ little in appearance from the cinnamon of Ceylon, but by far the greater proportion are larger, thicker, deeper-coloured, rougher, denser, and of a shorter fracture. The pieces are often much rolled upon themselves, but sometimes not completely quilled. The odour and taste are of the same general character; but the former is less agreeably fragrant, and the latter less sweet and grateful, though equally or more pungent, and more astringent.

In both varieties, the powder is of a yellowish-brown colour, so characteristic that, when met with in other bodies, it is distinguished by the name of cinnamon colour.

Active Constituents. These are a peculiar volatile oil, and tannic acid, the latter of which is not in large proportion. The oil is separated by distillation with water; being generally prepared in the East, probably from the broken fragments and refuse barks. There are two kinds of oil, distinguished as *oil of cinnamon* and *oil of cassia*, the former obtained from the Ceylon, the latter from the Chinese bark. Both oils, as first procured, are of a fine yellow colour; and both become red by age. The flavour of the proper cinnamon oil, however, is sweeter and finer than that of the oil of cassia. Both, when oxidized by exposure to the air, yield cinnamic acid.

Cinnamon yields its virtues in small proportion to water, and much more freely to alcohol.

Medical Properties and Uses. This bark has in a very high degree the general properties of the aromatics, with some astringency, dependent on the tannic acid. It is among those most employed. It is used for all the purposes of the aromatics (see *page* 315), but most frequently in conjunction with other medicines, to qualify their taste, and render them more acceptable to the stomach. One of its most appropriate applications is to the treatment of diarrhœa, in association with other astringents and with chalk; a purpose to which the tannic acid it contains especially adapts it. It has also been highly recommended in uterine hemorrhage. In consequence of its peculiarly agreeable flavour, it is used as a constituent of a great number of officinal preparations.

Administration. Cinnamon is sometimes administered in *powder*, in the dose of from ten to twenty grains. It is often, in this state, associated with other medicines given in the same form.

The *Aromatic Powder* of the Pharmacopœias (PULVIS AROMATICUS, *U. S.*) consists of cinnamon, ginger, cardamom, and nutmeg; a very fine combination of spices. From ten to thirty grains of this may be given for a dose. It is occasionally applied externally in the form of *cataplasm*, which may be prepared by adding a little heated spirit so as to bring the oil into activity, and rendering the mixture adhesive by honey or other viscid substance. Such a cataplasm may be advantageously applied to the epigastrium in vomiting, and over the whole abdomen in the cholera of children.

An officinal *Confection* (CONFECTIO AROMATICA, *U. S.*) is prepared by incorporating the aromatic powder above referred to with clarified honey. It may be used for the general purposes of the aromatics, in the dose of from ten grains to a drachm.

An *infusion* of cinnamon may be made by macerating two drachms in a pint of boiling water, and given in the dose of one or two fluidounces; and the bark may be added to other substances in infusion in the same proportion. When added to decoctions, it should be introduced at the end of the boiling, but while the liquid is still boiling hot.

The *Oil of Cinnamon* (OLEUM CINNAMOMI, *U. S.*) is never used alone, in an undiluted state; as, independently of its extreme pungency, it might endanger serious irritation, if not inflammation of the stomach. In overdoses it may prove fatal. Mitscherlich killed a dog in forty hours with two drachms, and in five hours with six drachms. But, made into emulsion with gum arabic, loaf sugar, and water, it will produce all the effects of cinnamon except those dependent on its astringency; and may often be administered advantageously as a stomachic and carminative. It is, however, more frequently employed in solution, in one of the following forms. The dose of it is one or two drops.

Cinnamon Water (AQUA CINNAMOMI, *U. S.*) was formerly made by distilling water from cinnamon, and this is recognized in the U. S. Pharmacopœia as an alternative process; but it is now much more generally and conveniently prepared by dissolving the oil in water, through the intervention of carbonate of magnesia, as described under the general head of aromatics (see *page* 317). Although only thirty minims are employed to two pints of water, the resulting solution is too strong for ordinary purposes, unless diluted. It is chiefly employed as a menstruum or vehicle for other medicines, given in liquid mixture or solution; but, when used for this purpose, it should generally be diluted with an equal measure or double its measure of water. The dose of this aromatic water is from half a fluidounce to a fluidounce.

Spirit of Cinnamon (SPIRITUS CINNAMOMI, *U. S.*) is prepared by dissolving a fluidounce of the oil in fifteen fluidounces of stronger alcohol. The dose is from ten to twenty drops.

A *Tincture of Cinnamon* (TINCTURA CINNAMOMI, *U. S.*, *Br.*), prepared, according to their ordinary method, both by the U. S. and British Pharmacopœias, affords an agreeable mode of obtaining the effects of the aromatics, with the astringency of the cinnamon, when alcohol is not contraindicated. The dose is from one to four fluidrachms.

◆

The two following barks, though little used, are noticed in most works on Materia Medica, and, as appears to me, can be nowhere more appropriately considered than as subordinates to cinnamon.

1. CANELLA. *U. S.*

This is the bark of *Canella alba*, a large tree growing in Jamaica and other West India islands. The bark is stripped from the branches, deprived of its epidermis, and dried.

Sensible Properties. It is in pieces of various size, usually thicker and larger than the coarsest cinnamon, either completely or partially quilled, often twisted, of a pale-orange or light reddish-yellow colour on the outer surface, nearly white on the inner, brittle with a short fracture, and yielding a yellowish-white powder. Its odour is aromatic, its taste warm, bitterish, and very pungent.

Active Constituents. A *peculiar volatile oil* is the main active ingredient; but there is also a *bitter substance*, and an *aromatic resin*, which are probably not without influence. The bark yields its virtues imperfectly to water, but readily and wholly to alcohol.

Medical Properties and Uses. Canella has the properties of the aromatics generally, with a greater degree of pungency than most of them, and some tonic power. It is well adapted to atonic states of the stomach and bowels; but is seldom used except in conjunction with other medicines, of which it may cover the taste, and correct any nauseating or griping property. The dose of the powder is from ten to thirty grains. Associated with aloes, it forms the *Powder of Aloes and Canella* (PULVIS ALOËS ET CANELLÆ, *U. S.*), which was formerly so much esteemed as to have received the name of *hiera picra*, or sacred bitter, though now comparatively little used. Whatever its virtues may be, they must be ascribed almost exclusively to the aloes, of which the canella is merely a corrective. Canella is also an ingredient in the *Wine of Rhubarb* (VINUM RHEI, *U. S.*).

2. WINTER'S BARK.—WINTERA.

This has been of late rejected from the Pharmacopœia, and owes what little attention is now paid to it to old associations. It is the bark of *Drimys Winteri* (*Wintera aromatica*, Willd.), an evergreen tree, growing in the southern extremity of the American continent, along the straits of Magellan, and thence northward to Chili and Brazil. As found in commerce, the bark is in quills about a foot long by an inch in diameter, or in larger flat pieces. On the outside it appears as if it had been scraped or rubbed, and has a pale-yellowish or reddish-gray colour, with red elliptical spots; the inner surface is reddish-brown or cinnamon coloured. Its powder resembles that of Peruvian bark. Its smell is fragrant, its taste hot, pungent, and spicy. Its chief active constituent is a peculiar volatile oil, with which there is also a somewhat acrid resin, and sufficient tannic acid to cause the infusion to be darkened by the salts of iron.

Winter's bark was first made known by Captain Winter, who commanded one of the vessels in Drake's famous expedition, and, on his return to England, in 1579, brought some of the bark with him. It has often been confounded with canella, which it resembles in appearance; but it may be distinguished by its dark inner surface, while that of canella is white, and by affording with reagents evidence of containing tannic acid, which canella does not.

Its medical properties are essentially the same as those of canella, and it may be used for the general purposes of the aromatics; but it is seldom to be found in the markets of the United States, and is little employed. The dose of the powder is about half a drachm.

III. CLOVES.

CARYOPHYLLUS. *U. S.*—CARYOPHYLLUM. *Br.*

Origin. Cloves are the dried unexpanded flower-buds of *Caryophyllus aromaticus*, a small and beautiful tree, inhabiting the Molucca Islands, in the East Indies, whence it has been successfully transplanted to various parts of the world, as the Isle of France, Singapore, Sumatra, and Cayenne in South America, in which places it is now cultivated to a considerable extent.

Sensible Properties. Cloves have the form of a small nail, being on the average somewhat more than half an inch long, with a round head, having four spreading points beneath it. When pressed with the finger-nail, if of good quality, they exude oil. Their colour is dark-brown, their odour strong and fragrant, and their taste hot, pungent, aromatic, and lasting. The powder is dark and oily.

Chief Constituents. The active principle of cloves is a *volatile oil*, which may be separated by distillation. When first procured, it is colourless, but gradually becomes yellowish by time, and ultimately reddish-brown. It has the odour and taste of the cloves; but is relatively less pungent. It is heavier than water. Besides the oil, there are two crystalline principles, called respectively *caryophyllin* and *eugenin*, and a little *tannic acid;* but the first two are insipid, and the last is of no practical importance. Cloves yield their active matter only in small proportion to water, but freely and entirely to alcohol. The alcoholic extract is excessively fiery, but becomes insipid when distilled, while the oil which comes over is relatively mild. Distillation would appear, then, to have produced some change in the oil, which renders it less active.

Medical Properties and Uses. Cloves were made known to Europe by the Arabians, but were not largely used until after the discovery of the passage to India by the Cape of Good Hope. They possess, in a high degree, the characteristic properties of the aromatics, and may be used for all the purposes mentioned in the general observations on this subdivision of the tonics. They are, however, much more employed as a condiment in cookery, than as a medicine. Occasionally they are given to correct nausea, relieve flatulent pains, and stimulate the languid digestion; but their chief medicinal employment is as an adjuvant to other medicines, and they form a subordinate ingredient in several officinal preparations.

The dose of the *powder* is from five to twenty grains. The officinal *Infusion* (INFUSUM CARYOPHYLLI, *U. S.*) is made with two drachms of the cloves to a pint of boiling water, and given in the dose of two fluidounces. The French Codex directs a *tincture*, of which the dose is a fluidrachm. The *Oil of Cloves* (OLEUM CARYOPHYLLI, *U. S.*), prepared by distillation from cloves, is occasionally employed either alone, in the dose of from two to six drops, properly diluted, or as an ingredient in purgative pills, to prevent nausea or griping. It is also used to relieve toothache, by being introduced, upon cotton, into the carious hollow. It relieves the pain by blunting the sensibility of the part through excessive irritation.

IV. NUTMEG.

MYRISTICA. *U.S.*, *Br.*

Origin. Nutmeg is the kernel of the fruit of *Myristica moschata*, a handsome middle-sized tree, originally confined to the Moluccas, but now cultivated in Sumatra, Java, Singapore, Cayenne, Brazil, and other intertropical countries. The product, however, is said nowhere to attain such perfection as in its native islands. The fruit, about the size of a small peach, has an outer covering or hull; and within this is a red membrane with slits, through which is seen a chestnut-coloured nut. The shell of the nut being broken, the kernel is obtained, and, having been steeped in a mixture of lime and water, and afterwards cleaned, is prepared for market.

Sensible Properties. The appearance of the nutmeg is too well known to require description. When broken, or cut through, it presents a yellowish surface, with dark, branching veins, in which volatile oil abounds. It is not very easily pulverized by pounding, and is reduced to powder by grating or grinding. It has a fragrant odour, and a warm, spicy taste, and is among the most grateful of the aromatics. It yields its virtues much more readily, and in larger proportion, to alcohol than to water.

Chief Constituents. The most interesting constituents of nutmeg are a volatile and fixed oil, the former of which is obtained by distillation with water, the latter by expression with heat. The *volatile oil* is lighter than water, colourless or of a pale straw colour, with the odour of nutmeg, and a pungent, aromatic taste. It is the active principle of the medicine. The *fixed oil*, often though erroneously called *oil of mace*, concretes, after expression, into a soft unctuous solid, of a yellowish or orange-yellow colour, often more or less mottled, and of the smell and taste of the nutmeg, owing to a proportion of the volatile oil contained in it.

Medical Properties and Uses. Nutmeg seems not to have been known to the ancients. The Arabians were acquainted with it; but it was little employed in Europe until after the discovery of the maritime passage to India. It has the ordinary properties of the aromatics, and, in large doses, is somewhat narcotic. In the quantity of two or three drachms, it has produced delirium and stupor; but no danger need be apprehended from it in the ordinary medicinal doses. It is more used as a condiment, or to give flavour to ordinary drinks, than as a medicine; and, in the latter capacity, it is chiefly employed to cover the taste and qualify the action of other substances. It is an excellent addition to farinaceous drinks used as a diet by the sick.

The dose of the *powder* is from five to twenty grains. The *Volatile Oil* (Oleum Myristicæ, *U.S.*) may be used, for any of the purposes of the aromatics, in the dose of two or three drops. There is an officinal *Spirit* (Spiritus Myristicæ, *U. S.*), prepared by distilling proof spirit from bruised nutmeg. In the quantity of from one to four fluidrachms, it forms an elegant addition to tonic and purgative infusions, when the stimulus of alcohol is not forbidden. The *expressed oil* is sometimes used as a gentle rubefacient in local rheumatism and palsy, and is an ingredient in *Emplastrum Picis* of the British Pharmacopœia.

Mace (MACIS, *U. S.*) is the membrane above referred to as surrounding the nut in the fruit. It is in flat, longitudinally slit pieces, of a rather soft consistence, of a reddish colour, and an odour and taste recalling those of nutmeg, but different and peculiar. Like nutmeg, mace contains a *volatile* and a *fixed oil.* It may be used for the same purposes as that spice, but is much less agreeable, and proportionably less employed.

V. BLACK PEPPER.

PIPER. *U. S.*, *Br.*

Origin. Black pepper consists of the dried unripe berries of *Piper nigrum*, a climbing plant, indigenous in the East Indies, where it is also largely cultivated, especially on the coast of Malabar, in the peninsula of Malacca, in Siam, and in the islands of Java and Sumatra.

White pepper is the ripe fruit, deprived of its outer coating by maceration in water. It is weaker than the black, and is little used in this country.

Sensible Properties. Black pepper is too well known to require description. Its odour and taste are familiar to every one.

Chief Constituents. These are volatile oil, a soft acrid resin, and a peculiar crystalline principle called piperin. The *volatile oil* may be separated by distillation with water. It is at first limpid and colourless, but becomes yellow by age. Its odour is strong, and resembles that of pepper; but the taste, though warm and pungent, is less acrid than that of the berries themselves. The acrimony resides chiefly in the *soft resin*, which is semi-fluid, of a deep-green or blackish colour, extremely acrid, insoluble in water and the volatile oils, but readily dissolved by alcohol and by ether. *Piperin* is a crystalline substance, white, inodorous, and tasteless when perfectly pure; but, as commonly obtained, yellow and acrid. At least this is the statement made by Pelletier; but Dr. Christison says that the whitest and purest crystals he had been able to procure were as acrid as the coloured, and emitted an intensely irritating vapour when thrown on a heated iron plate. It is insoluble in cold water, slightly soluble in hot water, and readily soluble in alcohol, ether, and acetic acid.

Medical Properties and Uses. Black pepper has been known as a medicine and condiment from the time of Hippocrates. It has the properties of the aromatics in general, but is much more stimulating than most of them, and acts with still greater proportionate energy on the stomach than on the general system. It is thought to have a specially excitant effect on the urino-genital apparatus, and probably stimulates the urinary passages through the direct contact of some one of its ingredients, altered or unaltered, with the mucous membrane of these passages, as it escapes with the urine. In contact with the skin, it is highly irritant, acting as a rubefacient, and sometimes, it is said, blistering. When taken too largely, it may produce serious irritation or inflammation of the stomach, with general febrile phenomena; and its long-continued use in excess endangers a loss of excitability in that organ, with or without chronic gastritis. It is much more employed as a condiment than as a medicine. In the former capacity, it not only serves to impart an agreeable flavour, but often facilitates the digestion of substances ordinarily of difficult solution in the stomach, especially fresh vegetables when boiled. Care should be taken, however, not to abuse it, for fear of the evil consequences just referred to. As a medicine, it is given occasionally in torpidity of the stomach and bowels, with flatulence, especially in old people, in whom these organs are apt to be inert. It is thought to act directly upon the mucous coat of the rectum, and thus to prove useful in chronic ulcers of that part, in piles, and fistula in ano. From its influence upon the urinary and genital passages, it has been recommended in gonorrhœa, gleet, and leucorrhœa; but care should be taken not too much to excite these parts, when there is any tendency to acute inflammation.

Much attention has been directed to black pepper from its supposed possession of antiperiodic properties. It was recommended in paroxysmal fevers by Celsus and Dioscorides; but, though occasionally used in domestic practice in intermittents, it seems for a long time to have been lost sight of by the profession. Louis Frank, in imitation of a practice which he had witnessed in the East, was induced to try it in this complaint, and found it successful in a hundred and seventy cases, which recovered as rapidly as under cinchona, and with less tendency to relapse. (Trousseau et Pidoux, *Trait. de Thérap.*, etc., 4e ed., ii. 465.) Many others followed the example of Frank, and the remedy came into great repute, which it has not yet entirely lost. There is no doubt that it will often cure intermittents; and, in cases of great torpidity of stomach, as in drunkards, it may with advantage be associated with sulphate of quinia, in order to arouse susceptibility to the action of the latter remedy. When used alone, it should be preceded by a thorough evacuation of the bowels; and it is recommended to administer it in the form of whole grains, as less liable than the powder to irritate or inflame the stomach.

In reference to its local effects, black pepper is sometimes used as a direct application to the mouth or fauces, in paralysis of these parts, relaxed uvula, severe toothache, etc. Externally it may often be usefully employed as a rubefacient, for which purpose it may be made into a cataplasm, with or without other irritants.

It may be given whole, or in powder. The dose is from five to twenty grains. In intermittents it has been recommended preferably, as already stated, in the whole form; and eight or ten grains of it may be given three or four times a day.

There is an officinal *Confection* (CONFECTIO PIPERIS, *Br.*), consisting of black pepper and caraway, incorporated with honey. It has been highly recommended in piles, in which it is employed as an officinal substitute for an empirical remedy, which acquired much credit, in the treatment of this affection, under the name of *Ward's paste*. Sir B. Brodie has found it successful in severe cases, and recommends that it should be continued for two, three, or four months. The dose is from one to three drachms, twice or three times a day. It should be accompanied with a laxative, in order to prevent inconvenient accumulation in the bowels; and should not be used when the parts are inflamed.

An *Oleoresin* (OLEORESINA PIPERIS, *U. S.*; EXTRACTUM PIPERIS FLUIDUM, *U. S.* 1850) is directed by the U. S. Pharmacopœia, in which the virtues of the medicine are extracted by ether, and this fluid subsequently evaporated. It contains the volatile oil and acrid resin of the pepper; and, as the piperin is of doubtful efficacy, may be considered as representing the virtues of black pepper. It is a thick, opaque, greenish liquid, having the smell of pepper, and an acrid, burning taste. A residuary matter, left in the process of preparing piperin, has been kept in the shops, under the name of *oil of pepper*. It has a black colour, and is essentially of the same character as the fluid extract, though of less uniform strength, and therefore less to be relied on. The dose is one or two minims, which may be given in emulsion, or in connection with other medicines in the pilular form.

Piperin has had considerable reputation in the treatment of intermittent fever, having been supposed to be the active principle of black pepper. As found in the shops, it certainly has some effect, and has been used successfully in that complaint. Dr. Meli an Italian physician, who was the first, I believe, to employ it, considered it superior to Peruvian bark. It has been much employed also in this country, particularly in connection with sulphate of quinia. As before stated, however, there is much reason to doubt its efficiency when pure. According to Pelletier, the acrid taste, and consequently the medicinal activity of the impure form in which it is commonly found, are owing to a portion of the acrid resin remaining mixed with it. The dose is stated at from one to ten grains. A drachm has been given in twenty-four hours without inconvenience. Meli considers that two or three scruples are sufficient to cure intermittents.

An *ointment*, made by rubbing one part of powdered pep- [illegible] with three or four parts of lard, was formerly employed in scald-head, but is little used at present.

VI. CUBEBS.

CUBEBA. *U. S., Br.*

Origin. Cubebs are the dried unripe fruit of *Piper Cubeba* (*Cubeba officinalis* of Miquel), a climbing perennial of the E. Indies, inhabiting especially Java and the neighbouring islands.

Sensible Properties. The fruit is spherical, about the size of a small pea, and furnished with a short stalk, continuous with a network of raised veins which surround the berry. Their colour in mass is a dark gray; some of the berries being almost black, others much lighter-coloured. The powder is dark and oily, and bears no inconsiderable resemblance to that of opium, which has been fatally mistaken for it. The odour is peculiar and aromatic, the taste warm, bitterish, and camphorous, imparting a sense of coolness when the air is drawn through the mouth. Water very imperfectly extracts the virtues of cubebs, alcohol and ether completely. They gradually deteriorate by age, and, as this deterioration takes place most rapidly in powder, they should be kept whole, and pulverized as wanted for use.

Chief Constituents. These are volatile oil, an acrid resin, and a peculiar principle called *cubebin.* The *volatile oil*, which is obtained by distillation with water, is when pure quite colourless, but, as commonly met with, yellowish or greenish. It is lighter than water, of about the consistence of olive oil, of an odour like that of cubebs, and a warm, aromatic, camphorous taste. The *resin* is, according to Vauquelin, somewhat acrid, and has a balsamic odour and taste resembling those of copaiba. *Cubebin* is closely analogous to piperin, and, when pure, quite destitute of odour and taste. The chief active constituent is undoubtedly the volatile oil, the operation of which is somewhat aided by the resin. Cubebin is probably inert.

Medical Properties and Uses. It is probable that cubebs were known to the ancient Greeks. The Arabians certainly were acquainted with them, and by these they were introduced into Europe. Employed for the same purposes as black pepper, they were at once feebler and less agreeable, and fell at length into entire neglect. It is only about forty or fifty years since the use of them was revived, in consequence of the favourable reports of English physicians in India, as to their efficacy in the treatment of gonorrhœa, in which they had been long employed by the native practitioners. Cubebs have the properties of the stimulant aromatics, with a peculiar direction to the urinary organs. When freely taken, they produce a feeling of warmth in the stomach, increase the frequency of pulse and heat of skin, sometimes occasion giddiness or headache, and, in consequence of the absorption of the volatile oil, and its escape through the kidneys, augment the secretion of urine, and impart to it a peculiar odour. In excess, they may cause burning in the stomach, nausea and vomiting, griping pains in the bowels with more or less of a laxative effect, irritation or inflammation of the urinary passages, and a general febrile condition. Occasionally their operation, in ordinary doses, is attended with a rash upon the surface, somewhat resembling urticaria. Though applicable to the same purposes as pepper, in reference to their cordial operation on the stomach, it is mainly in the treatment of gonorrhœa, and other affections of the urino-genital organs, that they are employed. They are recommended in the earliest stage of gonorrhœa, and, thus given, occasionally produce speedy cures; but they often also fail, and have been accused of increasing inflammation, and aggravating any existing tendency to swelled testicle. They should, I think, be used with caution when inflammation exists, beyond that which is an essential constituent of the affection; and it is probable that their greater efficacy in the earliest stage is owing to the circumstance, that highly inflammatory symptoms have not yet been developed. They probably operate through a direct alterative influence of the urine, impregnated with their properties, upon the portion of mucous membrane affected. In the advanced or chronic stage of gonorrhœa, and in gleet, though perhaps less efficient, they would be less likely to produce mischievous effects. Upon the same principle as in this complaint, they have been recommended in chronic cystirrhœa, chronic pyelitis, leucorrhœa, abscess of the prostate, and other conditions of the urinary and genital passages, in which a moderate stimulation of the diseased surface is indicated.* They are said to have proved useful in piles. Some suppose them to have an alterative action on the mucous surfaces generally, and therefore recommend them also in chronic bronchial affections, attended with copious expectoration, and a relaxed condition of the tubes.

Administration. The most common form of exhibition is that of *powder*, of which from ten grains to half a drachm is usually given in affections of the bladder, kidneys, and bronchial tubes; but in gonorrhœa the requisite dose is larger, varying from half a drachm to three drachms, three or four times a day. The *volatile oil* (OLEUM CUBEBÆ, *U. S.*), which is obtained by distilling cubebs with water, may be employed in emulsion, or dropped on sugar, in the dose of ten drops to begin with, gradually increased till its effects on the urinary passages have become evident. The dose has sometimes been increased to a fluidrachm. An *Oleoresin* (OLEORESINA CUBEBÆ, *U. S.;* EXTRACTUM CUBEBÆ FLUIDUM, *U. S.* 1850) is directed by the U. S. Pharmacopœia. It is made by extracting the virtues of the medicine with ether, and then allowing the ether to evaporate. It is a greenish-brown fluid, of variable consistence, and may be given in doses of from five to thirty minims, either mixed with sugar, or suspended in sweetened water. There is an officinal *Tincture* (TINCTURA CUBEBÆ, *U. S.*), of which the dose is from thirty minims to two or three fluidrachms.

---

* Dr. Caudmont has obtained peculiar advantages in affections, whether inflammatory or neuralgic, of the neck of the bladder and the prostatic portion of the urethra, from a combination of cubebs with copaiba. The medicine may be given in the form of bolus, each containing about six grains of the mixed medicine, and of which from fifteen to twenty-five are to be given in the twenty-four hours. (*Bulletin Gén. de Thérap.*, Juillet 30, 1861.)

◆

I do not know where better to introduce the following medicine, than in a subordinate position to pepper and cubebs, with which it agrees in botanical affinities, and, to a considerable degree, in its effects.

MATICO. *U. S.*—MATICA. *Br.* This consists of the herbaceous parts, more especially the leaves, of *Piper angustifolium* (*Artanthe elongata*, Miquel), a shrub growing in Peru. The medicine, as imported, usually consists of the dried leaves, spikes, and stalks, mixed together, and closely flattened by pressure. They are of a greenish colour, and, when pulverized, yield a greenish, light, absorbent powder. They have an agreeable aromatic odour, and a strong spicy taste. These properties, as well as their medical virtues, they yield readily to alcohol, and less perfectly to water. Their active constituents are volatile oil, a bitter principle, soluble in alcohol and water, called *maticin*, and probably resin. They contain neither tannic nor gallic acid.

Matico has long been used in Peru, externally as a styptic in hemorrhage, and a stimulant to ulcers, and internally as an aphrodisiac, and a remedy in venereal diseases. But it was not introduced into Europe until 1839, when a portion of it was taken to Liverpool, and prescribed by Dr. Jeffreys, of that place, in various diseases. Its effects on the system are those of an aromatic tonic and stimulant, bearing no inconsiderable resemblance to those of pepper and cubebs. It has been employed, with asserted advantage, in chronic inflammation of the mucous membranes, as gonorrhœa, leucorrhœa, catarrh of the bladder, and dysentery, and as a hæmostatic in hemorrhage from the nostrils, lungs, stomach, urinary organs, and uterus. If useful in these latter affections, it is not through any astringent properties, of which it is quite destitute, but probably by an influence analogous to that of oil of turpentine, which is often an efficient remedy in hemorrhage. Its chief use, given internally, is as an alterative to chronically inflamed mucous membranes. As a local styptic, it has been highly recommended. In this application, it probably acts mechanically, by absorbing the blood, and favouring its coagulation. The dose of the powder is from half a drachm to two drachms, three times a day. The *Infusion* (INFUSUM MATICÆ, *Br.*), directed in the British Pharmacopœia, is made in the proportion of half an ounce to ten fluidounces of boiling water, and given in the dose of one or two fluidounces. The Dublin College formerly directed a *Tincture* (TINCTURA MATICO), of which the dose was from one to three fluidrachms.

VII. PIMENTO.

PIMENTA. *U.S., Br.*

Origin. Pimento consists of the dried unripe berries of *Myrtus Pimenta* (*Eugenia Pimenta* De Cand.), a [illegible] tree growing in the West Indies, Mexico, &c. [illegible] and cultivated in Jamaica, whence the fruit [illegible] the name of *Jamaica pepper*.

Sensible Properties. [illegible]

Active Constituents. According to [illegible]

Medical Properties and Uses. [illegible]

The dose of the powder [illegible]

Pimento (AQUA PIMENTÆ, *Br.*) is made either by distilling water from the bruised fruit, or by simply dissolving the oil in distilled water, and given in the dose of one or two fluidounces. A *Spirit of Pimento*, prepared by dissolving the oil in diluted alcohol, was formerly officinal; but it has been omitted in the late revision of our Pharmacopœia. The dose was one or two fluidrachms, or more.

VIII. CARDAMOM.

CARDAMOMUM. *U. S.*, *Br.*

Origin. This is the fruit of *Elettaria Cardamomum*, a perennial plant, with clustered stems, from six to twelve feet high, and bearing its fruit upon a flower-stalk, which springs from the base of the stem, and lies along the ground. It is a native of the mountains of the Malabar coast of Hindostan, where also it has been cultivated from time immemorial.

Sensible Properties. The fruit is a coriaceous capsule, about half an inch in average length, and seldom more than three lines thick, three-sided, with rounded angles, somewhat wrinkled longitudinally, of a dirty-whitish or yellowish-white colour, and containing small, angular, irregular seeds, of a deep-brown colour, and appearing as if embossed on the surface. The odour of cardamom is highly fragrant, the taste warm, grateful, pungent, and purely aromatic. The capsular covering has little of the aromatic property, which resides mainly in the seeds. In making, therefore, the preparations of cardamom, the former should be rejected; although, as the seeds keep better in the capsule than when exposed, they should not be separated until wanted for use.

Active Principle. The virtues of cardamom reside exclusively in a *volatile oil*, which is lighter than water, colourless, and highly pungent and aromatic; but it is so liable to deterioration by time, that it is seldom kept separate for use. Water dissolves the oil from the seeds in small proportion; but alcohol is a much better solvent.

Medical Properties and Uses. Cardamom was probably known to the ancient Greeks and Romans, and has been employed in India, as a condiment, from the earliest times. It is among the most agreeable and purest of the aromatics, less stimulating than many others, whether locally or generally, and therefore highly useful, as an adjuvant, under circumstances which might forbid the use of a less mild article of the class. Though seldom given alone, it is very much employed to aid or correct the action of other remedies, and enters into a large number of officinal preparations, particularly tinctures. Perhaps no aromatic, on the whole, answers better than this as an addition to tonic and purgative mixtures and infusions, where the object is merely to cover the taste, obviate nausea, and produce a slight cordial impression on the stomach; and it is considerably used for this purpose in various officinal preparations, as the *aromatic powder*, the *compound extract of colocynth*, *compound tincture of gentian*, *tincture of rhubarb*, and *wine of aloes*.

When used alone, it is most conveniently given in *infusion*, which may be made with one or two drachms of the bruised capsules to a pint of boiling water; and in the same proportion they may be added to compound infusions. The dose is two fluidounces, or more. There are two officinal *Tinctures* of this aromatic specially, one *simple* (TINCTURA CARDAMOMI, *U. S.*), and the other *compound* (TINCTURA CARDAMOMI COMPOSITA, *U. S.*, *Br.*); the latter containing, in addition, cinnamon, caraway, and honey, and coloured red with cochineal. The honey was substituted, in the U. S. preparation, for raisins, which are directed in the British Pharmacopœia; and it is very doubtful, in my estimation, in reference to the sensible properties of the tincture, whether the change was an improvement. These are agreeable preparations, especially the compound tincture, which is much used as an extemporaneous addition to stimulant, tonic, and purgative mixtures and infusions, in the quantity of one or two fluidrachms for each dose of the preparation.

◆

IX. FENNEL-SEED.

FŒNICULUM. *U. S.*, *Br.*

Origin. Fennel-seed is the fruit of *Fœniculum vulgare* (De Cand.), *F. officinale* (Merat and De Lens), and possibly *F. dulce* (De Cand.). These are perennial umbelliferous herbs, growing wild in the South of Europe and in Asia Minor, and cultivated both in Europe and the United States. The whole plant, in the different species, has a grateful aromatic odour and taste, on account of which F. dulce is cultivated in Southern Europe; the shoots being eaten raw, or in the form of salad.

Sensible Properties. Fennel-seed consists usually of the separated half-fruits (mericarps) of the plant, usually called seeds. These are oblong-oval, flat on one side and convex on the other, occasionally connected by their flat surfaces, and of a grayish-green colour, with yellowish longitudinal ridges on the convex surface. There are two varieties, one smaller, a line or two in length, always in separate half-fruits; the other larger, three or four lines long, of a lighter colour, more prominent ridges, often connected together forming whole fruits, and with a short footstalk. The former comes probably from F. vulgare, the latter from F. officinale. Both have a pure aromatic odour and taste, peculiar and very agreeable. They impart their sensible properties and virtues to water and alcohol, but more largely to the latter.

Active Principle. Fennel-seed depends for its activity exclusively on a *volatile oil*, which is obtained by distillation with water, is lighter than water, colourless or yellow, and of a very grateful flavour.

Medical Properties and Uses. The ancients were acquainted with this medicine. It is purely aromatic, mild in its action on the stomach, and scarcely stimulant, in ordinary doses, to the system at large. Being less heating than cloves, cinnamon, ginger, or even cardamom, and yet of a very grateful flavour, it is preferable to these aromatics, when there is an indication at the same time for their peculiar influence, and for the avoidance of over-excitement, whether local or general. In the form of infusion, or of fennel water, it is often employed in infantile cases to relieve flatulent colic, and to obviate nausea. It may sometimes be useful for the former purpose, given as an enema. It is one of the best additions to purgative medicines, and is often associated with senna, rhubarb, and magnesia, in infusion or mixture.

An *Infusion* may be made in the proportion of two drachms to a pint of water, and given in the dose of two or more fluidounces to an adult, and two or three fluidrachms to an infant.

The *Volatile Oil* (OLEUM FŒNICULI, *U.S.*) may be used in doses of from five to fifteen drops as a carminative or antiemetic; and may be associated with other substances in pill, lozenge, or confection, to give them flavour, or enable them to sit better on the stomach.

Fennel Water (AQUA FŒNICULI, *U. S.*) is made by dissolving the oil in distilled water, by the instrumentality of carbonate of magnesia. In the British Pharmacopœia, it is directed to be made by distilling water from the seed; and the same directions are given in our national code as an alternative process. The dose for an adult is one or two fluidounces, for an infant as many fluidrachms. It is a very good vehicle for medicines given in the form of mixture.

◆

There are several other aromatic fruits, the medical properties and uses of which so closely resemble those of fennel, that what is said of one may be nearly as well said of all; one being preferable to another, mainly from its according better with the taste or stomach of the patient. It is unnecessary, therefore, to do more than name them, and very briefly describe their origin and distinctive physical properties.

1. CARAWAY.—CARUM. *U. S.*—CARUI. *Br.*

Caraway consists of the half-fruits or mericarps, commonly called seeds, of *Carum Carui*, a small biennial umbelliferous plant, growing wild in many parts of Europe, and cultivated both there and in this country.

They are usually separate, about two lines long, rather flat, slightly curved inwards, with five yellowish longitudinal ridges, and intervening spaces of a dark-brown colour. They have an aromatic odour and taste, which depend on a *volatile oil.* This, when separated by distillation, is at first colourless, but becomes yellow with age, and ultimately brownish. It is lighter than water. The medical properties and uses are the same as those of fennel-seed. An *Infusion* is prepared in the same way, and used in the same dose. The *Volatile Oil* (OLEUM CARI, *U.S*; OLEUM CARUI, *Br.*) is likewise used for the same purposes, and in the same manner as that of fennel-seed, in a dose varying from one to ten drops. It is occasionally applied to the relief of toothache, by being introduced upon cotton into the carious cavity. It probably acts by deadening sensibility through its powerful stimulation. There is an officinal *Water* (AQUA CARUI, *Br.*), which is prepared from the seeds by distillation, and used like fennel-water. The old London *Spirit of Caraway* was abandoned in the preparation of the British Pharmacopœia. Caraway was known to the ancients.

2. CORIANDER.—CORIANDRUM. *U.S.*, *Br.*

This is the fruit of *Coriandrum sativum*, a small plant inhabiting Egypt and the South of Europe, and cultivated for use. It is commonly called *coriander seed.* It is spherical, about the eighth of an inch in diameter, grayish-brown, obscurely ribbed, and separable into two portions or half-fruits. The odour and taste are agreeably aromatic, and must be familiar to all who have eaten the confectionery product called sugar-plums, each of which generally contains one of the fruits. These properties depend on a volatile oil, which, however, is not separated for medicinal use. The fruit may be employed in infusion, and is occasionally added to other substances administered in this form. It enters into a number of officinal preparations, among which is that excellent laxative, the *confection of senna.* The dose of powdered coriander is from thirty grains to a drachm. It was known to the ancients, and is mentioned in the Hebrew Scriptures.

3. ANISE.—ANISUM. *U. S.*

Anise is the fruit of *Pimpinella Anisum*, a small plant, native of Egypt and Syria, but introduced into the South of Europe, where, as well as in Germany, it is cultivated for use. Each fruit, commonly called seed, is about a line long, oval, striated, slightly downy, and of a gray yellowish-green colour. It usually has a small footstalk attached. The smell and taste are agreeably aromatic. Its virtues depend on a *volatile oil*, which, when separated by distillation, is lighter than water, colourless, or yellowish, and of the odour and taste of the seeds. Anise imparts its virtues to water, but more readily and largely to alcohol. It is much used for imparting flavour to liqueurs. Its medical virtues are simply those of the aromatics; but it has been supposed to increase the flow of milk, of urine, and the menses. The milk is said to acquire the odour of anise when it is taken by nursing women; and it has been asserted to give an unpleasant smell to the urine. The *Volatile Oil* (OLEUM ANISI, *U. S*, *Br.*) is more employed than the fruit itself. Dr. Ruschenberger, U. S. N., discovered in it the remarkable property of completely deodorizing a solution of tersulphide of potassium (sulphuret of potassa). A single drop of the oil was sufficient to overcome, instantly and entirely, the offensive smell of twenty grains of the tersulphide, dissolved in two fluidounces of water. (*Am. J. of Med. Sci.*, Oct. 1864, p. 419.) It is easy to conceive of numerous modes in which this property of the oil may be very usefully employed. The dose of the oil is from five to fifteen drops. It is an ingredient in several officinal preparations, among which may be especially mentioned the *Camphorated Tincture of Opium*, or common paregoric elixir. A *Water* and *Spirit* were formerly officinal in the London Pharmacopœia, but they have been omitted in the British. Anise was used by the ancients. Poisonous effects have happened in consequence of mistaking the seeds of Conium maculatum for aniseed.

4. STAR ANISEED.—ANISUM STELLATUM.

This is the fruit of *Illicium anisatum*, an evergreen tree, growing in China, Japan, and Tartary. It consists of from five to ten brownish ligneous capsules, four or five lines long, each containing a brown shining seed, and connected together at one end, in a star-like form. It has almost precisely the odour of anise, and yields by distillation a volatile oil, which closely resembles the oil of anise, and is often substituted for it without inconvenience. This is the more singular, as there is no botanical affinity between the two plants. Either the star aniseed, or its oil may be used for the same purposes as fennel-seed.

5. DILL.—ANETHUM. *Br.*

The fruit of *Anethum graveolens*, or common dill-plant, though little employed in this country, is still considerably used in Great Britain, and retains a place in the British Pharmacopœia. The plant is annual and umbelliferous, belonging to the same family as the fennel and caraway, and producing a similar fruit. It is a native of the south of Europe, and is cultivated almost everywhere in gardens. The fruits, commonly, though erroneously, called seeds, are about a line in diameter, and distinguished from the other officinal fruits of this kind by a yellowish membranous expansion that surrounds them. They have an aromatic odour and taste, but less agreeable than those of anise, caraway, or fennel, and have consequently not been introduced into our Pharmacopœia. These properties they owe to a volatile oil, which is separated by distillation. Water and alcohol extract their virtues. The *Oil* (OLEUM ANETHI, *Br.*) and a *Distilled Water* (AQUA ANETHI, *Br.*), prepared from the fruits, are the forms in which dill is most commonly used. It is given for the general purposes of the aromatics; the fruits in the dose of from a scruple to a drachm, and the oil in that of three or four drops. *Dill water* is used mainly as a vehicle.

X. LAVENDER.

LAVANDULA. *U. S.*

Origin. Lavender consists of the flowers of *Lavandula vera*, a small shrub, growing wild in the South of Europe, and cultivated everywhere in gardens The flowers are arranged around a terminal flower-stem, forming long, slender spikes. These are cut at the commencement of their flowering in August, and tied in bundles, which are sold both fresh and dried.

Sensible Properties. The separated flowers are small, blue, and of a remarkably fragrant odour, which they retain long after being dried, sometimes even for years. Their taste is warm, aromatic and bitterish. Though they yield their virtues in a moderate degree to water, alcohol is a much more efficient solvent.

Chief Constituents. The flowers contain a volatile oil, a bitter principle, and tannic acid. Though all of these have some activity, the virtues of the medicine depend mainly upon the *volatile oil.* This is obtained by distillation with water. It is very light, and of a pale lemon-yellow colour, with the fragrance of the flowers, and a burning aromatic taste.

Medical Properties and Uses. Lavender has the properties of the aromatics, with a feeble tonic power, and probably a slight stimulant influence upon the nervous system. Its odour alone is often refreshing in languor and general uneasiness; and it is probably more employed in reference to its fragrant properties, than internally as a medicine. Some of its preparations, however, are in considerable vogue.

The *Volatile Oil* (OLEUM LAVANDULÆ, *U. S.*), which is also officinal in the British Pharmacopœia, though the flowers are not, may be given internally in nervous headache and languor, as well as for its cordial aromatic properties, in the dose of from one to five drops. It is, however, much more used in the form of alcoholic solution.

The Spirit of Lavender (SPIRITUS LAVANDULÆ, *U. S.*) is made, according to the officinal directions, by distilling alcohol from the flowers: but much more commonly by simply dissolving the oil in alcohol, in the proportion of a fluidounce to a gallon; and the latter mode of preparation is recognized in the British Pharmacopœia. Made in the former method, it is more agreeably fragrant. The *lavender water* of the shops is usually a solution of the oil of lavender, with some other aromatic oils, in alcohol. Spirit of lavender is useful in the sick room for its grateful and refreshing odour. It may be given internally for the relief of nervous headache, languor, and depression of spirits, in the dose of one or two fluidrachms; but its frequent use might lead to intemperate habits, by originating a fondness for the alcoholic ingredient; and it should not, therefore, be incautiously prescribed. The following is a far more popular preparation.

The *Compound Spirit of Lavender* (SPIRITUS LAVANDULÆ COMPOSITUS, *U. S.; TINCTURA LAVANDULÆ COMPOSITA, *Br.*) is made, according to the U. S. Pharmacopœia of 1860, by dissolving the oils of lavender and rosemary in alcohol, percolating with the solution a mixture of powdered cinnamon, cloves, nutmegs, and red saunders, and adding, towards the close of the operation, enough diluted alcohol to give a certain measure to the percolated fluid. When duly prepared, it is a delightful compound of the spices, of which the lavender is not the most important. It is much used in gastric uneasiness, flatulence, colicky pains, nausea, general languor, faintness, depression of spirits, and slight hysterical disorder. But the same caution is necessary, in prescribing it, as mentioned in reference to the preceding preparation. It is much employed popularly, under the name of *lavender compound*, and, it is to be feared, not unfrequently when there is no real occasion. It is one of the best additions to mixtures, in order to recommend them to the taste and the stomach. Its red colour is sometimes of advantage, in otherwise colourless preparations, as in the solution of arsenite of potassa or Fowler's solution, by preventing their being mistaken for water. The dose is from thirty minims to a fluidrachm.

XI. ROSEMARY.

ROSMARINUS. *U. S.*

Origin. This consists of the tops of *Rosmarinus officinalis*, an evergreen shrub, inhabiting the shores of the Mediterranean, and cultivated in the gardens of Europe and this country. As found in our shops, it consists chiefly of the leaves.

Sensible Properties. The leaves are distinguished by their linear shape, their length of an inch and more, their breadth about one-sixth of an inch, the faded greenness of their upper and the whiteness of their under surface, and by a singular folding backward of both edges, which causes the colour of their under surface to be concealed on each side by a green border, leaving only a slender streak of whiteness in the middle. They have a balsamic odour, and a bitterish and camphorous taste, and yield these properties to water and alcohol, but much more freely to the latter.

Active Principles. Rosemary owes its virtues to a *volatile oil*, which is obtained by distillation with water. It is lighter than water, colourless, of an odour similar to that of the plant, but less agreeable, and a hot somewhat aromatic taste.

Medical Properties and Uses. Rosemary, though in some degree aromatic, is more characterized by its stimulant and rubefacient properties. It agrees, however, with the aromatics, in being proportionably more stimulating locally, than upon the system at large. Some have believed it to possess emmenagogue properties; but when it has appeared to promote the menstrual discharge, it has probably been simply as a general stimulant. In this country it is seldom used internally, except as an ingredient in some officinal preparation, as the compound spirit of lavender. The *Volatile Oil* (OLEUM ROSMARINI, *U. S.*, *Br.*) is recognized in both the U. S. and Br. Pharmacopœias, though the leaves, from which it is procured, are rejected by the latter. It may be given as a carminative, or gastric stimulant, in the dose of from three to six drops. The *Spirit* (SPIRITUS ROSMARINI, *Br.*) is made by dissolving the oil in alcohol, and is used almost exclusively either as a perfume, an ingredient in rubefacient liniments, or as one of the constituents of the compound spirit of lavender.

◆

XII. PEPPERMINT.

MENTHA PIPERITA. *U. S.*

Origin. Peppermint is the herb of *Mentha piperita*, a small, herbaceous perennial, indigenous in Europe, but naturalized in this country, and cultivated largely in England and the United States. The herb should be gathered at the flowering period in August.

Sensible Properties. Peppermint has a quadrangular stem, branching near the top, from one to two feet long, with leaves opposite, petiolate, ovate, serrate, pointed, dark-green on the upper surface, and paler on the under. The flowers are small, purple, and arranged in terminal spikes, which are rounded at top, and interrupted beneath. All parts of the plants are aromatic, either fresh or dried; but the herb rapidly deteriorates by keeping, and at length becomes inert. It has a penetrating, grateful, somewhat camphorous odour, and a pungent, glowing, camphorous, bitterish taste, which is followed by a sense of coolness when the air is drawn through the mouth.

Active Principles. The virtues of the herb may be said to depend exclusively on its volatile oil; for, though there is a trace of tannic acid, and probably a small proportion of some bitter principle, these are insufficient materially to modify its effects. The *volatile oil* is obtained by distillation with water. It is at first nearly colourless, but gradually becomes greenish-yellow, and ultimately reddish-brown. Its odour and taste are like those of the herb. It is lighter than water. It is often adulterated, especially with alcohol, which, if in considerable quantity, may be readily detected by agitation with water, which abstracts the alcohol from the oil, and thus diminishes its bulk.

Medical Properties and Uses. Peppermint has all the characteristic properties of the aromatics, and may be used for all their general purposes (see *page* 315). The fresh herb is sometimes applied externally, well bruised, over the stomach and bowels, in infantile vomiting and colic. It is a good remedy, thus employed, in the earlier stages of cholera infantum. Internally the medicine may be given, in the form of infusion, in colicky pains and flatulence; but the preparation almost universally employed in this way is the volatile oil.

The *Infusion*, made in the proportion of half an ounce to a pint, may be given in doses of a wineglassful.

The *Oil* (OLEUM MENTHÆ PIPERITÆ, *U. S.*, *Br.*) is very much used in this country, being almost universally preferred to the herb for obtaining the effects of the medicine by internal exhibition. It is recognized in the British Pharmacopœia, and directed to be prepared by distillation of the herb; though the herb itself is not among its officinals. The dose of it is from one to three drops, which may be prepared for administration by first rubbing it with a little loaf sugar, and then mixing with water. In consequence, however, of its extreme pungency, the oil is usually given dissolved in water or alcohol, in one of the following preparations.

Spirit of Peppermint (SPIRITUS MENTHÆ PIPERITÆ, *U. S.*, *Br.*; TINCTURA OLEI MENTHÆ PIPERITÆ, *U. S.* 1850) or *essence of peppermint*, as the preparation is generally called, is made by dissolving a fluidounce of the oil in fifteen fluidounces of stronger alcohol, and afterwards macerating with the solution, for twenty-four hours, two drachms of the powdered leaves, which are separated by filtration. In the British process the oil is simply dissolved in the alcohol. The spirit is of such a strength as to admit of being taken into the mouth, simply dropped on a piece of sugar. It is a very popular preparation, and often used for the relief of nausea, gastric pains, colic, and flatulence. The dose is from ten to twenty drops. It may be given as above stated, simply dropped on a piece of sugar, or diffused by means of sugar in water.

Peppermint Water (AQUA MENTHÆ PIPERITÆ, *U. S.*), formerly prepared exclusively by distilling water from the fresh herb, is now made by simply dissolving the oil in water, through the intervention of carbonate of magnesia. The present U. S. Pharmacopœia, however, admits distillation from the herb as an alternative process. Peppermint water is probably more used in this country as a vehicle for substances given in the form of mixture, than any other aromatic preparation. It serves to render the mixture more acceptable both to the palate and stomach, and to obviate griping. Each fluidounce of it contains about a minim of the oil. It may be given internally, for the ordinary purposes of the medicine, in the dose of from one to three fluidounces.

Peppermint Lozenges (TROCHISCI MENTHÆ PIPERITÆ, *U. S.*), consisting of the oil, sugar, and mucilage of tragacanth, afford a convenient form of the medicine for slight cases; as they may be carried in the pocket, and one of them taken as required. They are to be allowed slowly to dissolve in the mouth. They are, however, very feeble; ten of them being scarcely equivalent to a minim of the oil.

XIII. SPEARMINT.

MENTHA VIRIDIS. *U. S.*

This is the herb of *Mentha viridis*, an herbaceous perennial plant, like the above species a native of Europe, and naturalized in this country, where it is also cultivated for use.

The herb differs from peppermint in having lanceolate, nearly sessile, and lighter-coloured leaves, and elongated, pointed spikes of flowers, whence the name of spearmint was derived. The brighter greenness of the leaves probably gave origin to the specific name of *viridis* or green. The plant is often called simply *mint*; and, when that term is used without a qualifying epithet, it may be understood as applied to the present species. Its smell and taste are analogous to those of peppermint, but peculiar, and by some preferred. Others, however, and probably the greater number, give precedence to the mentha piperita.

The active principle is the volatile oil, though, as in peppermint, there is a small proportion of tannic acid and of a bitter principle. The oil closely resembles that of the other species.

The same resemblance extends to the medical properties and uses of the two mints; but the spearmint is thought to be somewhat the weaker. The same preparations are used, and in about the same doses. Those of spearmint recognized by the U. S. Pharmacopœia, are the *Volatile Oil* (OLEUM MENTHÆ VIRIDIS, *U. S.*), of which the dose is from two to six drops; the *Spirit* or *Essence of Spearmint* (SPIRITUS MENTHÆ VIRIDIS, *U. S.;* TINCTURA OLEI MENTHÆ VIRIDIS, *U. S.* 1850), of which from twenty to forty drops may be given; and *Spearmint Water* (AQUA MENTHÆ VIRIDIS, *U.S.*, *Br.*), made and used in the same manner as the corresponding preparation of peppermint. An *infusion of spearmint* was formerly directed by the *Dublin College*, made in the proportion of about half an ounce of the herb to a pint of water. Though abandoned in the British Pharmacopœia, it may nevertheless be useful, when the oil is not at hand. It may be given without special limitation of the dose.

* * *

There are several aromatics of minor importance, consisting of the herb or leaves of plants, which, though not extensively used, are yet sufficiently so to require a brief notice, and may, perhaps, be best introduced in a subordinate position here.

1. EUROPEAN PENNYROYAL.—PULEGIUM.

This formerly held a place in all the three Pharmacopœias of Great Britain and Ireland, but has been discarded in the British. It is, therefore, no longer officinal; but merits a brief notice in consequence of its former position. It is the herb of *Mentha Pulegium*, a European plant, having properties analogous to the mints above described, though less agreeable as an aromatic, and much less employed. It is used considerably in England as a domestic remedy in amenorrhœa, hysteria, and hooping-cough. In this country it is unknown. All the British Colleges formerly directed the *Volatile Oil* (OLEUM MENTHÆ PULEGII), and *Pennyroyal Water* (AQUA MENTHÆ PULEGII); the Dublin College, an *Essence* (ESSENTIA MENTHÆ PULEGII); and the London a *Spirit* (SPIRITUS MENTHÆ PULEGII); all of which were given for similar purposes, and in the same doses as the analogous preparations of peppermint.

2. AMERICAN PENNYROYAL.—HEDEOMA. *U. S.*

This is the herb of *Hedeoma pulegioides*, a small indigenous annual, growing in all parts of the United States, usually preferring dry, sterile, or impoverished fields, and sometimes, from its abundance, scenting the air for a considerable distance. Both fresh and dried, it has an agreeable aromatic odour, resembling somewhat the European pennyroyal from which it derived its name, and a warm, pungent, camphorous taste. These properties reside in a *volatile oil*, which may be separated by distillation. The oil is lighter than water, of a light pale-yellow colour, and a smell and taste similar to those of the plant. The herb imparts its virtues to hot water, but more freely to alcohol.

The effects of hedeoma upon the system are very analogous to those of the mints; and, like these, it may be used to correct nausea, relieve flatulent pains, and cover the taste or correct the action of other medicines. When given in the form of hot infusion, in large draughts, it often, like most other aromatic herbs, produces perspiration, and promotes the flow of the menses. Hence, it is considerably employed, in domestic practice, in commencing catarrh and rheumatism, and to promote menstruation; the feet being at the same time well soaked in hot water, and the patient covered warmly in bed. There is no doubt that the remedy, thus aided, is not unfrequently successful. As an emmenagogue it is most efficient in recent cases, and given at the regular monthly period, when it comes in aid of the tendencies of the system. It has little effect in obstinate cases. It has been used also, like the European herb of the same name, in hysteria and hooping-cough. The *Infusion* may be made in the proportion of half an ounce to the pint, and given in doses of from two to four fluidounces or more. The *Volatile Oil* (OLEUM HEDEOMÆ, *U. S.*) is officinal, and may be employed with the same objects as the infusion, in the dose of from two to ten drops. It is sometimes used externally as a rubefacient. A *water* and *spirit* or *essence* of pennyroyal may be prepared from the oil, in the same manner as the similar preparations of the mints, and used in the same way.

3. HORSEMINT.—MONARDA. *U. S.*

Horsemint is the herb of *Monarda punctata*, an indigenous herbaceous plant, a foot or two high, growing preferably in light and gravelly soils, from New Jersey to the Gulf of Mexico. Its odour is aromatic, its taste warm, pungent, and bitterish. These properties depend on a *volatile oil*, which is obtained by distillation, is of a reddish-amber colour, an odour similar to that of the plant, and a hot, very pungent taste. Hot water will extract the virtues of the herb, but alcohol is a better solvent.

Horsemint has the aromatic properties of the proper mints, but is more stimulating and less agreeable. It may be used as an antiemetic and carminative, and as a stimulant to the stomach in languid states of that organ; but is little employed in regular practice. An *infusion* may be made in the proportion of half an ounce to the pint, and given in wineglassful doses. Drank warm and freely, it will often induce perspiration, and has been thought to act as an emmenagogue; and, taken cold, it has been supposed to stimulate the kidneys. Hence it has been used in suppression of the menses, and of the urine.

The *Volatile Oil* (OLEUM MONARDÆ, *U. S.*) is more used. It may be given as a stimulant and carminative in the dose of two or three drops, mixed with sugar and water; but it has attracted more attention as an active rubefacient. Applied to the skin, it causes redness, heat, and pain, and sometimes blisters. In cases not demanding a powerful and speedy impression, it should be diluted with olive oil before application.

4. COMMON MARJORAM.—ORIGANUM. *U. S.* 1850.

This has been discarded both in the U. S. and British Pharmacopœias, and is no longer officinal. It is the herb of *Origanum vulgare* or *common marjoram*, a perennial, herbaceous plant, growing wild both in Europe and the United States, and in this country found especially by the roadsides, from Pennsylvania to Virginia. It bears a rather conspicuous summit of pinkish-purple, or rose-coloured flowers, which appear during summer and early part of autumn. The herb has an agreeable aromatic odour, and a warm pungent taste. For these properties it depends on a *volatile oil*, which is separated by distillation, and for which alone the plant was recognized as officinal. The oil as first prepared is yellow, but becomes reddish by age, and is said to acquire the same colour when over-heated in distillation; but it may be obtained colourless by rectification. It is lighter than water, has the odour of the plant, and a hot acrid taste.

Origanum is a stimulating aromatic, and will answer the same purposes as the mints; but, being less agreeable to the taste, and probably less cordial in its influence on the stomach, is little used. Like pennyroyal and horsemint, it has been supposed to be diaphoretic and emmenagogue; but, like them, probably acts in this way simply as a general stimulant, and when aided with suitable accompaniments, such as hot water in the form of infusion, and hot pediluvia. The *oil* is a powerful local irritant, and is sometimes employed as such externally, either alone or in connection with other medicines. Diluted with olive oil, it is used as a liniment in baldness, rheumatism, sprains, bruises, and paralytic affections. Occasionally it is employed to relieve toothache, being introduced on lint or cotton into the carious hollow. It was an ingredient in the discarded *Camphorated Soap Liniment* of former editions of our Pharmacopœia, so much employed, under the common name of *opodeldoc*, as an anodyne and gently rubefacient application.

Sweet Marjoram (*Origanum Majorana*) has been used, in powder, as an errhine, but has lost its place in the officinal lists, and is now seldom employed except as a spice in cooking.

5. THYME. — THYMUS.

Thyme is the herbaceous part of *Thymus vulgaris*, a small undershrub, growing wild in the South of Europe, and cultivated in our gardens. It has a characteristic, strong, agreeable odour, which it retains when dried, and a pungent, aromatic camphorous taste. These properties reside in a *volatile oil* (OLEUM THYMI, *U. S.*), which is obtained, in the native districts of the plant, by distillation, and is said to be sent into commerce largely, under the name of *oil of origanum*, by which it is often sold in the shops. Indeed, so commonly was it substituted for the oil of origanum, that the U. S. Pharmacopœia, discarding entirely both the origanum and its oil, have adopted the oil of commerce with the name of oil of thyme, without, however, recognizing the plant itself in its officinal lists. It is lighter than water, and has at first a pale-yellow or greenish-yellow colour, which it gradually exchanges for a reddish-brown. As found in our shops, it is usually of a red colour, which is asserted to be that of the oil at the first distillation; the colourless oil being obtained by redistilling the red. I suspect, however, that, as just stated, the redness is the result of exposure, as in the case of so many other volatile oils. Thyme has the medicinal properties of the aromatics, but is much more used in cooking than in medicine.

6. SAGE.—SALVIA. *U. S.*

Sage consists of the leaves of *Salvia officinalis*, or common garden sage, an undershrub of two feet or more in height, originally from the South of Europe, but cultivated everywhere in gardens. They have a strong fragrant odour, and a warm, bitterish, aromatic, and somewhat astringent taste. They contain *tannic acid*, and probably a bitter principle; but their virtues depend mainly on a *volatile oil*, which exists in them in large proportion.

The virtues of sage are those of a gentle tonic and astringent, and an efficient aromatic. In addition to its excitant influence upon the digestive organs and the circulation, it has been supposed also to stimulate the nervous and genital systems, and, when suitably aided, no doubt promotes perspiration. By the ancients it was very highly esteemed, and retained its credit as a remedy among the earlier modern Europeans, as evinced by the dictum of the school of Salerno, "*Cur moriatur homo cui Salvia crescit in horto.*" It was used as a stimulant tonic in weakness of digestion and general debility, as an astringent in checking profuse sweats and excessive lacteal secretion, as a febrifuge in paroxysmal fevers, as a diaphoretic in catarrh, and as an antispasmodic in various nervous affections. From these over-estimates of its virtues, it has fallen into probably unmerited disrepute, and has been abandoned by the British authorities, though retained in our own Pharmacopœia. It may be used with advantage as an antiemetic, carminative, and gentle stimulant to the stomach and bowels, especially when there is enfeebled digestion, with a tendency to diarrhœa. But the chief use now made of it medicinally is as a gargle in common sore-throat, and relaxation of the uvula, for which purpose it is employed in the form of infusion, and often associated with honey, and alum or vinegar. It is much used as a condiment in cookery, especially in the filling of roasted poultry, and in sausages. As a gargle, and when all its effects on the system are demanded, the infusion should be prepared by macerating an ounce of the leaves in a pint of boiling water, and the maceration continued till it cools. Two fluidounces may be given for a dose. When wanted to relieve nausea, or as an agreeable drink in febrile affections, the proportion of sage should be lessened, and the maceration shortened, so that the whole of the bitterness may not be extracted. The officinal *Infusion* (INFUSUM SALVIÆ, *U. S.*) is made with half an ounce to the pint.

7. BALM.—MELISSA. *U. S.*

Balm is the herb of *Melissa officinalis*, a perennial herbaceous plant, a foot or two in height, originally from the South of Europe, but naturalized in this country, and cultivated in our gardens. The leaves have, when fresh, a very agreeable lemon-like odour, which is nearly lost when they are dried, and entirely when they are long kept. In the recent state, they have a feebly aromatic and somewhat austere taste; in the dried, impart a slight degree of roughness to water. The fresh herb contains a little volatile oil, tannic acid, and bitter matter. Water extracts all its virtues. Upon the system it exerts but a very feeble influence; and it is chiefly employed, in the form of infusion, as an agreeable drink in fevers, and, taken warm, to promote the operation of diaphoretics. The infusion may be made with half an ounce or an ounce of the herb, to the pint of water. The fresh or recently dried herb should be preferred.

XIV. PARTRIDGE-BERRY.

GAULTHERIA. *U. S.*

Origin. Gaultheria consists of the leaves of *Gaultheria procumbens*, an indigenous, small, shrubby evergreen, inhabiting the woods or hill-sides, and dry sandy plains, from Canada to Georgia. It has a creeping, horizontal root, from which, at short intervals, erect stems arise, a few inches high, bearing the leaves near the summit, and a small spherical, scarlet, berry-like fruit. The plant is known by other names, as *tea-berry*, *mountain-tea*, *winter-green*, etc.

Sensible Properties. The leaves, which are the officinal part, are ovate or obovate, an inch or more in length, acute, revolute at the edges, with a few mucronate serratures, coriaceous, shining, of a bright-green colour on the upper surface, and paler beneath. These, as well as the whole plant, including the fruit, have a peculiar fragrant odour and aromatic taste, very similar to that of the *Betula lenta* or sweet-birch, and ascribable to a volatile oil, which is the same in both plants, and exists also in some others having similar sensible properties. Besides their aromatic properties, the leaves have a decided astringency, and the fruit is sweet.

Active Principle. The *volatile oil* is obtained by distillation with water. It is the heaviest of all known volatile oils, having the specific gravity 1.173. When first procured, it is nearly colourless; but as found in the shops, is generally brownish-yellow or reddish. The odour is that of the plant, the taste sweetish, somewhat pungent, and very peculiar.

Medical Properties and Uses. Gaultheria is a gently stimulant aromatic, and feeble astringent. For these properties, it has been used in some cases of chronic diarrhœa, and with supposed benefit. Like many other aromatics, it has been given as an emmenagogue; but has no other claim to this title than such as its gently stimulating property may give it. As a stomachic cordial and carminative, and for the relief of the flatulent colic of infants, it may be used like other aromatics, over which, however, it has no superiority. It has been sometimes used by people in the country, in the form of infusion, as a substitute for common tea. Its chief claim to notice, however, rests on its remarkable, and very peculiar flavour, which serves to characterize preparations, into the composition of which either the leaves or the volatile oil enter.

The *Oil* (OLEUM GAULTHERIÆ, *U. S.*) is more or less employed throughout the country, dissolved in alcohol in the form of an *essence*, for the same purposes as the oils of the mints. It may be prepared in the same way, and given in the same dose, as the essence of spearmint. In large quantities, the oil is capable of producing inflammation of the gastric mucous membrane. A case is on record in which half an ounce was swallowed, and occasioned the most alarming gastric symptoms, though the patient recovered. In the quantity of about a fluidounce, it is stated to have caused death in several instances, leaving strong marks of inflammation of the stomach. The oil is an ingredient of the *Compound Syrup of Sarsaparilla* of the U. S. Pharmacopœia.

◆

XV. GINGER.

ZINGIBER. *U. S.*, *Br.*

Origin. Ginger is the root or rhizome of *Zingiber officinale*, a biennial or perennial plant, two or three feet in height, a native of Hindostan, and cultivated in various parts of the East Indies, in the West Indies, and at Sierra Leone in Africa.

Varieties and Sensible Properties. Ginger comes in several different states. Sometimes it is imported fresh, and is then called *recent ginger*. As ordinarily used in medicine, it is in two states; in one with the epidermis remaining more or less completely, and prepared simply by exposure to the action of boiling water, so as to destroy the life of the root, and prevent germination; in the other, wholly deprived of the epidermis, and often whitened by a bleaching process. The former is called *black ginger*, or is designated by the places from which it is derived; the latter is named *white ginger*, and often *Jamaica ginger*, from the island of that name, whence this variety was first brought into commerce. Ginger is also imported in the form of a preserve; the tender young offsets from the old roots being selected for its preparation

Recent ginger is flattish, about three inches long, with short obtuse branches or lobes, on the surface of a light ash colour, internally fleshy and yellowish-white. It will keep for a considerable time, but is apt to germinate in warm weather.

Black or *coated ginger* is somewhat shrunk in drying, with a darkish, ash-coloured, wrinkled epidermis, which in some specimens is absent in spots, where the surface is blackish from exposure, and has thus given name to the variety. Beneath the epidermis is a brownish and somewhat horny layer; but the central portion is whitish and farinaceous. The powder is of a light yellowish-brown colour.

White or *Jamaica ginger* is wholly destitute of epidermis, more slender and rounder than the preceding, white externally, internally also whitish, and yielding a white or yellowish-white powder. Much of this variety is now imported from the East Indies; but, as obtained from this source, it is not so white as that from Jamaica.

The odour of ginger is aromatic and penetrating; its taste hot, pungent, biting, and aromatic. It yields its virtues to water and alcohol; but more completely and largely to the latter.

It is apt to be injured by worms, when long kept.

Chief Constituents. The active principles of ginger appear to be a *volatile oil*, and a *resino-extractive matter;* the flavour probably residing in the former, and the active properties mainly in the latter. There is also a considerable proportion of starch and gum, which render certain precautions essential in preparing the syrup.

Medical Properties and Uses. Ginger was employed by the ancients. It is a very grateful stomachic stimulant, having some incitant effect also on the circulation, and is one of the most useful of the aromatics. In *pure dyspepsia* it is often used with much benefit, either alone or in combination; and, when added to tonics, in this affection, it renders them at once more acceptable and efficient. In the feeble condition of the digestive organs attendant on *atonic gout*, it is also an excellent adjuvant to other measures. It is one of the best carminatives; and, in the form of hot infusion, is much employed in simple spasmodic or *flatulent colic*, especially in children. As a *preventive of cholera*, its cordial influence upon the digestive organs renders it peculiarly appropriate; and, in the epidemics of this complaint, it has been among the prophylactic medicines most relied on. It is very frequently used in connection with tonics and purgatives; with the former, to increase their stimulant effect; with the latter, to obviate griping; and with both, to cover their taste, and mitigate or prevent their nauseating effects. It is also much employed as a condiment in cookery.

Locally, ginger is actively irritant. When chewed, it produces a burning and painful sensation in the mouth, and increases the flow of saliva. Hence it is sometimes employed as a *masticatory* in toothache, rheumatic affections of the jaws or neighbouring parts, relaxation of the uvula, and palsy of the tongue, or other part of the mouth or fauces.

Snuffed up the nostrils, it produces sneezing, and increases the secretion of mucus, and is, therefore, occasionally used as an errhine. Upon the skin it acts as a *rubefacient;* and the powder, formed into a cataplasm with warm water, may often be advantageously applied to the cheeks in toothache, the forehead in headache, and over the stomach in irritable states of that organ.

Administration. Ginger is given internally, in the forms of powder, infusion, tincture, and syrup.

The dose of the *powder* is from ten to thirty grains. In this state it is often combined with powdered columbo, and subcarbonate of iron, and is an ingredient in the *Pulvis Aromaticus* of the Pharmacopœias.

The *Infusion* (INFUSUM ZINGIBERIS, *U. S.*) is made in the proportion of half an ounce of the bruised or powdered root to a pint of boiling water. The dose is one or two fluidounces; but it may be given more freely in urgent cases, especially of flatulent colic. In that affection, a small bowlful, sweetened, may sometimes be drank with advantage. In this form, ginger is much used in connection with the simple bitters, as gentian, quassia, and columbo, and with cathartics, especially senna and rhubarb.

The *Tincture* (TINCTURA ZINGIBERIS, *U. S.*), according to the directions of our national code, is made very strong, to fit it for the preparation of the syrup; and this concentration has also the advantage of increasing the proportion of the aromatic, and diminishing that of alcohol. This is the more necessary, as it is officinal alcohol and not diluted alcohol or proof spirit, that is used as the menstruum; the latter causing the tincture to become turbid, in consequence of the quantity of mucilage dissolved.

Under the name of *essence of ginger*, a still more concentrated preparation is made, either by employing a larger proportion of ginger, or preferably by evaporating a portion of the alcohol of the tincture, and filtering.

Either of these preparations may be given as a carminative and stomachic stimulant, or added to tonic and purgative infusions, tinctures, and mixtures, in debilitated states of the alimentary canal. The dose of the *tincture* is from forty minims to a fluidrachm, that of the *essence*, according to the degree of its concentration, from twenty to forty minims.

The *Syrup* (SYRUPUS ZINGIBERIS, *U. S.*) is prepared from the tincture, because, by this method, the starch and gummy matter of the root are avoided, which, if present in the syrup, would dispose it to spoil. The alcohol is driven off during the process. Syrup of ginger is an excellent addition to tonic and purgative infusions, and to other liquids used for drink, especially to carbonic acid water, when one of the alkaline carbonates or bicarbonates is exhibited with it in solution, as these are incompatible with most of the ordinary syrups, in consequence of the acid they contain. It is also a good vehicle for substances in powder, the taste of which it covers, while it gives them a suitable consistence for exhibition. Rubbed up with magnesia or its carbonate, it enables that medicine to be readily and uniformly suspended in water; at the same time covering its taste, and obviating its nauseating effect. A fluidrachm of it may be added to every fluidounce or two of the liquid with which it is administered.

Ginger Troches or *Lozenges* (TROCHISCI ZINGIBERIS, *U. S.*) are prepared in our Pharmacopœia by incorporating tincture of ginger with powdered tragacanth and syrup of ginger. They often answer a good purpose in relieving gastric uneasiness and flatulence, on being taken into the mouth and allowed slowly to dissolve. Those prepared by the confectioners may often be substituted without disadvantage. *Ginger beer* is one of the most wholesome of its class of beverages.

In its various forms, ginger is employed, as an adjuvant or corrigent, in a considerable number of officinal preparations.

◆

The four following roots appear to me worthy of a brief notice, either for their former reputation, or present use, however limited the latter may be.

1. ZEDOARY.—ZEDOARIA.

Two kinds of zedoary are noticed by authors, the round and the long; but the former only is now to be found in the shops. The round zedoary is the root of *Curcuma Zedoaria,* growing in the East Indies, where it is cultivated. It is usually in slices, which are the halves or quarters of a roundish root, ending in a point. These are marked, on their convex surface, with the sections of circular rings, which in the whole root surround it horizontally, and with small projecting points, which are the remains of the radical fibres. The root is grayish-white on the outside, yellowish-brown and somewhat marbled on the freshly cut surface, hard, and compact. Its odour is agreeably aromatic, and its taste bitterish, pungent, and camphorous. Its activity resides mainly in a volatile oil; but the bitterness is probably dependent on a distinct principle, which may add a slight tonic influence to the aromatic qualities of the root. Its medical properties and effects are essentially the same as those of ginger, though weaker. It is at present seldom if ever used in this country. The dose is from ten to thirty grains.

2. TURMERIC.—CURCUMA. *U. S.*

This is the root of *Curcuma longa,* a small perennial plant, indigenous in the East Indies and Cochin China, and abundantly cultivated in various parts of Southern Asia. There are two varieties, both produced by the same species of Curcuma, but distinguished by their shape, one being long, and the other round, and therefore named *curcuma longa* and *curcuma rotunda*. The former, or *long turmeric*, is much more abundant in the market than the latter. It is cylindrical, about as thick, but generally not quite so long, as the little finger, tuberculated, and somewhat contorted. The latter, or *round turmeric*, is round or oval, about the size of a pigeon's egg, or somewhat larger, and marked externally with numerous annular wrinkles. Both are yellowish on the outside, and of a deep orange-yellow within, compact, hard, exhibiting when broken a wax-like fracture, and yielding a yellow or orange-yellow powder. Turmeric has a peculiar aromatic odour, and a warm, bitterish, somewhat aromatic taste, and tinges the saliva yellow when chewed. Its medical properties probably reside exclusively in a *volatile oil*, which is yellow and acrid. It contains, however, another interesting principle, denominated *curcumin*, on which its colouring properties, and its use as a chemical test, depend. (See *U. S. Dispensatory.*) It formerly had some reputation as an aromatic, resembling ginger in its action on the system, though less efficient, and also less agreeable. It was also supposed to have a special influence upon the biliary organs, probably from its yellow colour, and was used in jaundice and visceral disease. At present, it is scarcely used as a medicine, and probably never in this country. As a condiment, however, it is largely consumed in the East, entering into the composition of most of the curries so much in favour there. Its chief use here is as a test for alkalies, which change its yellow colour to brown. For this purpose it is employed in the form of tincture, or of turmeric paper. The powder might be exhibited in the dose of from ten to thirty grains.

3. CALAMUS. *U. S.*

This is the root (rhizome) of *Acorus Calamus* or *sweet flag*, an indigenous plant growing also in Europe and Western Asia, and, in this country, abounding in low, meadowy grounds, too wet for the culture of the useful grasses. The plant may be distinguished, by those not acquainted with its botanical character, from the young cat-tails, and coarse grasses with which it is frequently associated, by the aromatic odour of the leaves when bruised, and their aromatic taste. The root is horizontal, jointed, somewhat flattened above and below, often several feet long, from half an inch to an inch thick, with numerous fibres or radicles proceeding from its under surface, which are cut off when it is dried, leaving little, round, permanent spots. When dried, it shrinks much. As kept in the shops, it is in pieces of various lengths, wrinkled, yellowish-brown externally, and whitish or yellowish-white internally. In some pieces the exterior cortical part has been removed, leaving the inner portion, the surface of which acquires a grayish-white colour. The odour is strong and fragrant; the taste warm, bitterish, pungent, and aromatic. It yields its virtues to boiling water. These may be considered as residing exclusively in a *volatile oil*, which is occasionally separated by distillation, is yellow, and has an odour and taste analogous to those of the root. There is said also to be an *acrid extractive matter;* but too little is known of it to justify the ascribing to it of any of the virtues of the medicine. *Starch* is another ingredient.

Calamus has been known from ancient times. It has medical virtues closely analogous to those of ginger, for which it might be substituted in most cases, though it is generally much less acceptable to the palate. There is one use of it which I would recommend from experience. Having some tenacity, though sufficiently brittle to be easily broken by the teeth, it may be carried in the pocket, and a little of it chewed as wanted. In this way it will often afford great relief to the gastric uneasiness, spasmodic pains, and flatulence so frequently attendant on dyspesia, nervous gout, and hysterical affections. The dose of it is from twenty grains to a drachm. An infusion, made with half an ounce or an ounce to a pint of boiling water, may be taken in the dose of two fluidounces or more. In the form of powder, calamus is said to have a strong preservative influence against the attacks of insects, if sprinkled over the object to be preserved. (*Med. and S. Reporter*, Sept. 24, 1864, p. 107.)

4. WILD GINGER.—ASARUM. *U. S.—Canada Snakeroot.*

Wild ginger is the root (rhizome) of *Asarum Canadense*, a very small, perennial indigenous plant, growing in wooded grounds, from Canada to Georgia. All parts of the plant have an agreeable aromatic odour, which is strongest in the root. This is in long, somewhat contorted pieces, of the medium thickness of a crowquill, hard and brittle, externally wrinkled and brownish, internally whitish, and often furnished with short radicles. Its taste is aromatic, bitterish, and grateful, bearing some resemblance to that of cardamom. The active principles are a *volatile oil*, and a *bitter acrid resin*. Water extracts them partially, alcohol completely.

Wild ginger is a stimulant aromatic, with tonic and diaphoretic properties, somewhat analogous to serpentaria in its operation, but with less of the characteristic effects of the simple bitters, and approaching more nearly the subdivision of tonics in which it is here placed. It may be used as a gentle stimulant and diaphoretic in low fevers; but I should be more disposed to employ it for the same purposes as ginger, for which the country people are said occasionally to substitute it, and its affinity for which is indicated by one of its common names. It might be appropriately used as an adjuvant of tonic and purgative infusions, in debilitated states of the alimentary canal. The dose of the powder is twenty or thirty grains. It may be given also in infusion, made with half an ounce of the root and a pint of boiling water, in the dose of two fluidounces. It would form an elegant tincture, which might be made by macerating four ounces in two pints of diluted alcohol, and used, as an addition to tonic infusions, in the quantity of one or two fluidrachms for each dose.

5. VANILLA. *U. S.*

Vanilla is one of the most agreeable of the aromatics; and it is singular that it should not have been sooner adopted by the Pharmacopœias. It is now recognized only in our own. It is the fruit of the *Vanilla aromatica* and probably other species of the same genus, climbing plants, indigenous in Mexico, the West Indies, and South America. The fruit is a long slender pod, which is collected before maturity, dried in the shade, then covered with a coating of oil, wrapped, several pods together, in sheet lead, and enclosed in metallic boxes. The prepared fruit has an exquisite odour and taste, dependent on a volatile oil, which is said to be generated in the drying process, and cannot be obtained separate by distillation with water.

Vanilla, besides being aromatic, is probably somewhat stimulant to the nervous system. It is very much employed by confectioners for its agreeable flavour; but has not been much used in medicine. It has been recommended in low fevers, and in hysterical affections, usually in the form of infusion, made in the proportion of half an ounce to a pint of boiling water, and given in the dose of half a fluidounce. It should be employed, more frequently than it is, to flavour medicine and food for convalescents. Nothing so agreeably flavours chocolate, ice-cream, and liquid custard. The only preparation in which it is officinally employed are the *Troches of Subcarbonate of Iron* (TROCHISCI FERRI SUBCARBONATIS, *U. S.*).

◆

III. TONICS OF MINERAL ORIGIN.

There is sufficient ground, in the different properties exercised by the different mineral tonics, for arranging them in three subdivisions; *one*, including those which, so far as their pure and direct tonic action is concerned, operate exclusively on the mucous membrane of the alimentary canal; *a second*, those which act on the system at large, and produce their effects by a direct influence upon the vital properties of the tissues, without entering necessarily into their composition; and *a third*, those which, though they may possibly operate in the mode just mentioned, are nevertheless peculiarly characterized by forming an essential element of some constituent of the body, and produce their remedial effects, either by increasing the amount of this constituent, or restoring it when diseased to its normal state by supplying a wanting ingredient. In the first subdivision may be ranked the mineral acids, as the sulphuric, nitric, muriatic, and phosphoric; in the second, the preparations of silver, copper, zinc, and bismuth; and in the third, the preparations of iron.

1. *Mineral Tonics Acting on the Stomach and Bowels.*

Mineral Acids.

The peculiarity of this subdivision is owing simply to the circumstance that, in consequence of their strong chemical affinities, they seem to be incapable of absorption into the circulation unchanged. Either their disposition to combine with salifiable bases causes them to be neutralized in the alimentary canal, and thus to lose their acid character; or a similar change in their nature takes place by union with one or more of the organic principles they meet with, as albumen for example, with which they readily unite; or they undergo decomposition; or lastly, they remain unchanged in the primæ viæ till expelled with the feces. Indeed, this incapability of absorption unchanged, is probably essential to the prevention of poisonous effects from them; as they might very dangerously react on the blood itself through their chemical affinities. Their direct effects, therefore, as mineral acids, are confined to the alimentary canal. Various secondary effects result, to which it will be necessary to call attention in considering them severally. These may even be of a tonic character; but the acids are, nevertheless, not less distinctly characterized, as a subdivision, by the peculiarity referred to.

I. SULPHURIC ACID.

ACIDUM SULPHURICUM. *U. S., Br.*

Sulphuric acid was known as early as the seventh century. As found in commerce, it is often called *oil of vitriol*, and is more or less impure, containing, among other foreign bodies, a small proportion of sulphate of lead, which, however, is thrown down when the acid is diluted with water; so that practically its presence is of less importance than might have been supposed. For an account of the chemical properties and characteristics of this acid, the reader is referred to the U. S. Dispensatory. I shall here treat of its relations to the human system, and afterwards of its preparations; premising that the strong acid, though much employed as a pharmaceutical agent, and sometimes as a caustic, is never directly prescribed for internal use.

Effects on the System. When taken in very small doses, sufficiently diluted with water, sulphuric acid produces at first no other observable effect than to increase the appetite. But, after a short time, digestion and secondarily nutrition are found to have been promoted; and a tendency to constipation is sometimes evinced. It is said also somewhat to reduce the frequency and fulness of the pulse, and to diminish the temperature of the body, especially if previously elevated; though I cannot say that I have myself ever noticed these effects. Dr. Christison, in his Dispensatory, states that it is also diuretic, and that it sometimes succeeds in producing an increased secretion of urine in dropsical effusions, when other powerful diuretics have failed. With these properties, sulphuric acid must be considered as tonic, astringent, refrigerant, and diuretic.

If given too freely, it produces uneasiness in the stomach, disturbance of digestion, griping pains in the bowels, and often purging; and the same effects may result from its too long continuance in proper medicinal doses. They are the direct consequence of its irritant action on the alimentary mucous membrane.

In large quantities, and even in smaller if taken in the concentrated state, as not very unfrequently happens by mistake, in consequence of the extensive use of the acid in the arts, it very quickly produces burning pain in the mouth, fauces, and stomach, with nausea and generally vomiting of bloody or dark coloured liquids, followed by excruciating pains in the bowels, sometimes attended with constipation, sometimes with purging and bloody stools. Occasionally there are spasms of the muscles of the face, back, and upper extremities, arising no doubt sympathetically, through irritation of the nervous centres. The voice often becomes hoarse from inflammation of the glottis; the breath sometimes fetid from the decomposition of the destroyed tissues; and generally, when a corrosive effect has been produced, great prostration comes on, with a cold surface, feeble and irregular pulse, intense anxiety, and incessant jactitation, which soon end in death; the mind remaining unclouded not unfrequently even to the very last. The fatal result sometimes takes place in a few hours, but more frequently at a period varying from twelve hours to two or three days, and occasionally is much longer protracted. When the quantity has not been sufficient to cause immediate death, the case may run on for weeks or months, with frequent vomiting of membranous flakes, fetid breath, great disturbance of the general system, and gradual emaciation, under which the patient at length sinks. Sometimes the effects are confined to the mouth and fauces; complete deglutition having been prevented by the excessive irritation, or other cause; and great destruction or inflammation of these parts may ensue, from which the patient may or may not recover. The appearances after death are those indicative of inflammation and disorganization of the mucous membrane. In some places, the surface is reddened by congestion; in others, whitened from a combination of the acid with the albumen of the tissue; and in others again, blackened by its decomposing effect, the blood being coagulated in the surrounding vessels Death results from the direct action of the acid on the alimentary mucous membrane, and probably in no degree through its absorption into the blood-vessels. Dr. Christison states that the smallest fatal dose of sulphuric acid which he had found recorded was a drachm, or somewhat more than half a teaspoonful. Patients, however, not unfrequently survive the effects of much larger quantities. A case of recovery is recorded after six drachms had been swallowed; but such a result must be very rare, and could probably occur only in consequence of a prompt evacuation or neutralization of the poison. From a few drachms of the dilute officinal preparation of the acid, recovery may be reasonably hoped for, if prompt measures of relief are applied, or the immediate occurrence of vomiting has caused nearly all the poison to be thrown off. A patient got well after taking ten drachms of the aromatic sulphuric acid, or elixir of vitriol, which had brought on vomiting and purging of blood. (*Lond. Med. Gaz.*, xxv. 944.)

The *treatment* of poisoning by sulphuric acid consists in the prompt exhibition of substances fitted to neutralize the acid, with diluent drinks to favour the complete washing out of the stomach, and afterwards in the use of measures calculated to allay the inflammation, and support the patient, if necessary, until the recuperative processes shall have been completed. The best antidotes are magnesia, chalk, and the bicarbonates of potassa and soda; but, in the absence of these, any salifiable base which may happen to be nearest should be at once resorted to, as soap, whiting, or even wood ashes mixed with water. The inflammation may be treated with demulcent drinks, and the ordinary antiphlogistic measures, carefully graduated to the amount of reaction, and the probable future strength of the patient. Where the stomach rejects everything, attempts should be made to support the system by animal broths injected into the rectum.

Mode of Operating. The first effect of the acid, given medicinally, is to stimulate the function of digestion. It probably enables the stomach to secrete the gastric juice more freely, upon the application of its proper stimulus, the food; and there is reason to think that it directly aids the solvent power of the juice itself, especially when, from a debilitated condition of the organ, that fluid may have been produced without the proportion of acid requisite for the due performance of this function. The phenomena which follow its more free exhibition are those purely of irritation of the mucous membrane, or of chemical corrosion. The astringency which it often exhibits, in its action on the alimentary canal, probably results chiefly from its direct influence on the vital property of contractility in the tissues, or from a similar influence of the salts which it forms with salifiable bases, present in the contents of the stomach and bowels. It has long been noticed that this acid is peculiarly apt to give astringency to its salts, more so, indeed, than any other mineral acid, as evinced in the effects of alum and sulphate of iron. Perhaps another mode in which it proves astringent is by a chemical combination between the acid and the albuminous constituent of the superficial epithelial layers, causing a contraction of the tissue beneath. Something of this kind may occur when it is taken very largely; but, as ordinarily given for medical purposes, in small doses and very much diluted, it is extremely improbable that it produces any such effect. In the prefatory remarks on the mineral acids, I have expressed my opinion very decidedly that they never enter the circulation as such. In fact, should they be absorbed, they could exist there only an instant uncombined; for they would immediately be neutralized by the alkalies or albumen of the circulating fluid. Orfila injected a little diluted sulphuric acid into the veins of a dog, and caused its almost immediate death, with coagulation of the blood. But though, in the uncombined state, it cannot enter the circulation, it is undoubtedly, I think, often absorbed in the state of saline combination; and, as its salts prove astringent in the stomach and bowels, they may exercise a similar influence on the tissues generally, through the blood. Hence we may account for the supposed efficacy of the acid in the relief of hemorrhages, to the seat of which it can have no direct access. Being, however, offensive to the system, when thus in excess in the blood, the salts are thrown off with the urine; and, in order that this elimination may be effected, it is probable that they have the property of stimulating the kidneys, and thus produce the diuresis, which has been noticed as an occasional result of the exhibition of sulphuric acid. It is not probable that the acid exerts any tonic influence on the tissues generally, other than the indirect promotion of sanguification and nutrition, by the invigoration of the digestive process. None of the salts of the acid, excepting those with a tonic base, as the sulphates of iron and zinc, act as tonics; and these metals produce their effects as well without as with the sulphuric acid. The absorption, therefore, of the salts it may form in the bowels, will not be followed by a tonic operation on the system. This is a point of more than merely speculative interest. If the opinion thus given be well founded, it would be useless to prescribe sulphuric acid with the view to a tonic effect, except in so far as it may be desirable to invigorate digestion.

Therapeutic Application. Sulphuric acid is admirably adapted by its local tonic powers to cases in which, without organic disease or vascular irritation of stomach, there is loss of appetite, with languid or inefficient digestion, general debility, and especially night-sweats. These conditions are often presented in the *convalescence from acute diseases*, particularly fevers, in which this acid, given alone, or in connection with the simple bitters, or some preparation of Peruvian bark, produces the happiest effects. The *hectic fever* of *scrofula* and *consumption*, and the advanced stage of *suppurative inflammation*, often afford similar indications.

In pure *dyspepsia* the medicine is little used; as, though it would seem to be indicated by the state of the digestive process, experience has not pronounced in its favour. To be curative in this affection, a remedy must be continued for a considerable time; and sulphuric acid, when its use is long persisted in, is apt to become irritant to the stomach, though well borne at first.

The acid has also been recommended as a tonic in *low typhoid* and *malignant fevers;* but I believe that it is of little advantage, and may often prove hurtful in these affections, by a too irritant action on the stomach, and through it indirectly on the system. It is only upon the alimentary canal, as before explained, that it acts directly as a tonic; and a mere gastric stimulant is not what is wanted in these cases.

With a view to its *conjoint tonic* and *astringent effect*, sulphuric acid has been employed in diarrhœa, cholera, hemorrhage, and colliquative sweats. In *diarrhœa*, connected with a relaxed state of the bowels, or in that complaint in its chronic form, and with a suspicion of ulceration of the mucous membrane, it has long been occasionally employed as an astringent or alterative; but it is only of late that it has been introduced, as the main remedial agent, into the treatment of *acute diarrhœas* in their earlier stages, and of *epidemic cholera*. In the *London Medical Times and Gazette* for January, 1852 (page 31), is a communication from Dr. H. W. Fuller, of London, strongly recommending the use of the acid in this affection, and ascribing the first public notice of the remedy to a letter of Mr. Griffiths, which appeared in the *Lancet* three months previously. In a subsequent communication to the same journal (Oct. 1853, p. 344), Dr. Fuller reiterates his recommendation, based now upon a very large experience of the remedy. He had found it especially adapted to "acute autumnal" or epidemic diarrhœa, and to that form of the disease which precedes cholera; and in all such cases, amounting to upwards of ninety, it had proved invariably successful. In many of the cases there were cold extremities, severe cramps, vomiting and purging, and sometimes even rice-water discharges. He found it of little use in bilious diarrhœas, and certain chronic cases of the disease. In *choleraic diarrhœa*, and in *cholera itself*, in its earlier stages, no remedy is, he thinks, equally efficient. These statements have been confirmed by reports from other practitioners, which have appeared in the London journals; though, in the hands of some, the remedy has proved of no avail, and has occasionally seemed to be injurious. The mode of exhibiting the acid is to give from twenty to thirty minims of the *diluted sul-*

phuric acid of the Pharmacopœias, with sufficient cold water to render it palatable, every hour until its beneficial effects are experienced. In some cases, Dr. Fuller recommends that the dose should be repeated every twenty minutes, or even more frequently, during the first hour. "Sometimes after the second dose," says Dr. Fuller, "more commonly after the third, and almost always after the fourth, the patient experiences a grateful sense of warmth at the epigastrium, heat returns to the extremities, the nausea and vomiting cease, the purging is stayed, the cramps subside, and the countenance reassumes its natural appearance." The patient goes on amending, and, after a few hours, the remedy may be suspended. If the acid be exhibited at intervals of six or eight, or even three or four hours, the same happy effects are not obtained. Should the liver not act properly after the cessation of the characteristic symptoms, a little blue mass may be exhibited. Some administer aromatic tinctures, opiates, or other adjuvants in conjunction with the acid; but Dr. Fuller prefers it simply diluted with water. In relation to the treatment of cholera itself, in its different stages, it would appear, from the statements in the return of the English Board of Health, that sulphuric acid can, at the best, boast of no superiority over other remedies. (*B. and F. Medico-chirurg. Rev.*, July, 1855, Am. ed., p. 108.)

In the *hemorrhages*, sulphuric acid is occasionally useful; but it does not stand among the most efficient remedies. In hemorrhage from the stomach and bowels it may do good by a direct action on the bleeding surface; but even here it has found no great favour with the profession generally. In that from surfaces which it cannot directly reach, as in hæmoptysis, hæmaturia, menorrhagia, etc., its efficacy has been doubted, upon the ground that it does not come in contact with the bleeding vessels; but it is probable, as before explained, that the saline compounds which it forms in the alimentary canal may enter the circulation, and these salts may be as styptic as the acid itself. Nevertheless, sulphuric acid has no sufficient hæmostatic power to be relied on exclusively in the treatment of the hemorrhages, and, for the most part, is employed merely as an adjuvant. The incompatibility between it and acetate of lead would forbid its use, in any case, in conjunction with the latter remedy.

In *colliquative sweats*, there are few remedies more efficacious than sulphuric acid. Its use in cases of this kind attending convalescence, the hectic of phthisis and scrofula, and the suppurative stage of inflammation, has been already referred to. But whenever excessive sweating occurs, especially if during sleep, and with general debility, as happens sometimes idiopathically, and often in connection with other diseases, the remedy may be resorted to with a reasonable hope of benefit. Generally, in such cases, it may be advantageously associated with sulphate of quinia. It probably acts either through the astringency of such of its salts as enter the circulation, or, what seems to me more probable, by a sympathetic propagation of its action on the bowels, through the nerve centres, to the surface of the body.

From its supposed possession of refrigerant properties, it has been recommended *in fevers generally;* but I have never seen it useful in cases where the prominent indication was to reduce the pulse and heat of the body; and I have, therefore, much doubt as to the existence of any property of this kind, at least in a sufficient degree to justify its use upon that ground alone. The saline compounds which it forms in the primæ viæ may, when absorbed, prove somewhat refrigerant, as the neutral alkaline salts generally are known to do; but if such an effect is produced in fevers, it is more than counterbalanced by the tendency of the acid to disturb the stomach, already but too prone to irritation.

The *phosphatic lithiasis*, or that condition of the system, and of the urinary organs, in which there is a disposition to an excessive formation and deposition in the urine of the earthy phosphates, is often treated with the mineral acids; and, among them, with the sulphuric. One object in the treatment of this affection is to maintain a due acidity of the urine, by which the phosphates are held in solution; and another, to give tone to the digestive organs, which are often in fault. Now, it was supposed that these objects would be accomplished by acid medicines, possessing, like the one in question, tonic powers; the supposition being entertained that the acid would pass out through the kidneys, and thus impregnate the urine. But the mineral acids are not absorbed as such; neither are they thrown off as such by the emunctories. As before stated, it is in the form of salts that they enter the circulation, and are eliminated. Nevertheless, experience has proved them to be among our best remedies, if not the best, in this affection; and, though they do not directly acidify the urine, it is very possible that they may do so indirectly. In the contents of the bowels, and in the blood, are salts, from which the acid matter normally contained in the urine is probably separated. The sulphuric acid introduced into the stomach must, in order to form salts, decompose some saline substance which it meets with in the primæ viæ; and the liberated acid may either be absorbed, and escape with the urine, or, in its turn, disengage from some one of the salts of the blood an acid to be thrown off by the kidneys.

Sulphuric acid had at one time some reputation as a remedy in *colica pictonum*, and is still considered a good prophylactic against that complaint, under certain circumstances. It was supposed to act by forming an insoluble and inert salt with the lead, and thus to remove the cause of the disease. But the preparations of lead do not produce colica pictonum, while lying loose in the alimentary canal, or even precipitated upon its surface. They must enter the circulation, and come into direct contact with the nervous tissue which they affect. Now, sulphuric acid cannot follow them into the circulation and the tissues; and, even if, in the form of soluble sulphates, it should do so, the formation of an insoluble compound of lead in these situations, from which it could not be readily removed, would not, it appears to me, be the best method of expelling the poison. So far as the acid can do good by combining with any lead in the stomach and bowels, thus far it may be useful in colica pictonum, by preventing the further absorption of the poison. It may, therefore, prove prophylactic, if habitually used as a drink by those who are exposed to the necessity of swallowing small quantities of lead with their saliva, or antidotal in those who may accidentally take the poison into the stomach in larger quantities; but all that it could do chemically in such cases, could be as well done, and with less liability to injury, by the use of one of the soluble sulphates. It must, therefore, act by some other than its mere chemical properties, if it has any special usefulness in the poison of lead; but that it has such usefulness, remains yet to be satisfactorily proved.

Dr. D. Darrach, of Quincy, Illinois, has found this acid, in several cases, very efficient in the expulsion of tape-worm. He used it in the form of the aromatic sulphuric acid or elixir of vitriol, of which he gave a drachm, diluted with several ounces of water, in the course of three or four hours. (*Am. J. of Med. Sci.*, Oct. 1860, p. 378.)

The acid has been used *externally* in eruptive affections, as *lichen*, *prurigo*, *obstinate urticaria*, and *psora*, and in indolent or ill-conditioned ulcers. It is also employed as a gargle in ulcerated sore-throat, and the anginose affection of scarlatina, and as a caustic application to diphtheric exudation in the mouth and fauces. But for all these purposes, its place has been supplied by more efficient or more convenient remedies; and it is now little employed. When used, it should be much diluted. The precise strength will be mentioned under the preparations.

Incompatibles. If the special action of sulphuric acid is wanted, it should not be given with metallic iron; with salifiable bases, with which it forms salts; with the carbonates, or salts of vegetable acids; with soluble nitrates, chlorides, iodides, or sulphurets; or with the soluble salts of lime, baryta, and lead, which it decomposes, forming insoluble or nearly insoluble sulphates of these bases respectively. Sometimes, possibly, it may be appropriately administered in connection with one or more of these substances; but this should never be done, unless with a view to the reactions which must follow.

Preparations of Sulphuric Acid.

As kept for internal use, sulphuric acid is always in one of the following forms. In relation to its external use as a caustic, it will be treated of under the *escharotics*.

1. DILUTED SULPHURIC ACID.—ACIDUM SULPHURICUM DILUTUM. *U. S., Br.*

This is prepared by the U. S. Pharmacopœia, by mixing two troyounces of concentrated sulphuric acid, with fourteen fluidounces of distilled water, then filtering, and passing through the filter as much more of the water, as may be necessary to make the diluted acid measure a pint. After the mixture, a white insoluble substance gradually separates, if the commercial acid is used in the preparation. It is the sulphate of lead previously contained in the strong acid, which would subside if the mixture were allowed to stand, and might be got rid of by decanting the clear liquid. In the U. S. process, it is separated by filtering. The British preparation is somewhat stronger, but not materially so. Even in this state of dilution, the acid is still corrosive, and requires to be much more diluted before it can be borne by the palate. The officinal preparation is intensely sour, and will set the teeth on edge, if it come in contact with them. When taken, therefore, it should either be sucked through a quill, or other tube introduced far into the mouth; or, what I think is ordinarily a better plan, it should be swallowed rapidly, and the mouth, immediately afterwards, well and repeatedly washed out with water, or a weak solution of one of the alkaline carbonates. Without some precaution of this kind, the teeth may be seriously injured.

The *dose* of the diluted acid is from ten to thirty drops, to be repeated, for ordinary purposes, three times a day, or more frequently. To be efficient in hemorrhages, it must be given every two hours. The dose should be taken in one or two wineglassfuls of water, sweetened or not, as the patient may prefer. When used as a drink in hemorrhages or fevers, the same quantity may be added to half a pint or a pint of water.

For a gargle, in ulcerative affections of the throat, a fluidrachm may be added to a pint of water; for application to the skin, double the quantity. When intended for pseudomembranous patches in the mouth or fauces, this preparation may be used undiluted, and should be applied by a brush directly to the affected part, and no other.

Compound Infusion of Roses (INFUSUM ROSÆ COMPOSITUM, *U. S.*) is an infusion of red roses, containing about three fluidrachms of the diluted sulphuric acid in two and a half pints. The preparation acquires a slight astringency and a red colour from the roses; but its efficacy depends altogether on the acid. It is considerably used in Great Britain, as a drink in hemorrhages and colliquative sweats, and as a vehicle for saline medicines, especially sulphate of magnesia, the taste of which it in some measure conceals. The dose is from two to four fluidounces. It is also used as a gargle.

2. AROMATIC SULPHURIC ACID.—ACIDUM SULPHURICUM AROMATICUM. *U. S., Br.*—*Elixir of Vitriol.*

This preparation, which is very generally known under the name of *elixir of vitriol*, is a simplification of *Mynsicht's acid elixir*. It is prepared, according to the present U. S. process, by obtaining a tincture of ginger and cinnamon by percolation with alcohol, and then adding the tincture to a mixture of sulphuric acid and alcohol previously prepared. It may be considered as a tincture of the aromatics mentioned mixed with the acid; though some chemical reaction has no doubt taken place between the several ingredients. It contains one part of the acid to about nine parts by measure of alcohol, and is therefore considerably stronger than the preceding preparation. As the drop, however, is smaller, the dose is about the same as given in drops. The U. S. preparation is about one-third stronger than the British. It is a reddish-brown liquid, of a peculiar agreeable odour, and, when diluted, of an acid not unpleasant taste. In this country, it is the form generally preferred for the internal administration of sulphuric acid. The dose of it is from ten to thirty drops, given in one or two wineglassfuls of water. It is very often used as an addition to sulphate of quinia to render it soluble in water; and is an ingredient in the two *Infusions of Peruvian Bark* of the U. S. Pharmacopœia, in the preparation of which it enables the water to extract all the virtues of the bark, while it agreeably qualifies the taste of the infusion.

3. OINTMENT OF SULPHURIC ACID.

This ointment was until recently an officinal of the Dublin College. It was made by rubbing together a drachm of the acid and an ounce of lard. Reaction took place, which altered the colour of the ointment; but it was still merely a dilute preparation of sulphuric acid for external use. Mixed with an equal quantity of lard, it was employed as a remedy for scabies, lichenous ringworms, prurigo, and other obstinate cutaneous eruptions, and, still further diluted, as a rubefacient in paralysis, chronic inflammation of the joints, rheumatism, etc.

II. NITRIC ACID.

ACIDUM NITRICUM. *U. S.*, *Br.*

Origin. This acid, according to Dr. Pereira, was known to Geber in the seventh century. In commerce it is usually denominated *aqua fortis*, and in technical language sometimes *azotic acid*. It is prepared by heating together a mixture of nitrate of potassa and sulphuric acid, and condensing in a receiver the vapours which are given off. For an account of its composition, chemical relations, the tests of its purity, etc., the reader is referred to the U. S. Dispensatory. It is here to be considered mainly in its direct medical relations.

Properties. Two forms of the acid are kept in the shops, distinguished as the *nitrous* and *nitric* acids.

Nitrous acid of the shops is characterized by its orange colour, which is sometimes very deep, and by the orange-coloured fumes which it gives off. This peculiarity is owing to its impregnation with nitric oxide or deutoxide of nitrogen, by reaction between which and a portion of the nitric acid, the proper chemical nitrous acid is generated, which imparts its colour to the mixture. But, when the liquid acid is diluted with water, the orange-coloured nitrous acid is decomposed again into nitric acid and nitric oxide, the latter of which escapes, assuming an orange colour when in contact with the air, and leaving a colourless diluted nitric acid; and, as the medicine must be diluted before being administered, it follows that the nitrous acid of the shops has nothing to distinguish it, in relation to medical effect, from the purer form. This observation is necessary, as peculiar virtues have been ascribed to it.

Nitric acid, when quite pure, is a colourless liquid, but, as often kept, is slightly yellowish. If duly concentrated, it gives out white fumes. As directed by the U. S. Pharmacopœia, it has the sp. gr. 1.42; but it is of variable strength as found in the shops. It has a peculiar odour, and, when so far diluted as to be borne in the mouth, an intensely sour taste. When in contact with the skin, it stains the cuticle yellow; and the colour remains until the cuticle itself is gradually removed, a property which serves to distinguish the stain from that produced by iodine and bromine. The colour, moreover, may be distinguished by becoming brighter under the application of ammonia or soap.

Effects on the System. Nitric acid, in the smallest medicinal doses, excites the appetite, promotes digestion, and secondarily invigorates the general nutritive process. It is, therefore, a *tonic,* acting specially on the stomach and bowels, and in this respect resembles sulphuric acid, from which, however, it differs in being without astringency. It is said also to be refrigerant, and to have alterative properties which render it useful in peculiar morbid states of the system. On these points more will be said directly. It is thought to have sometimes induced ptyalism; but, at best, this result is very rare.

Too largely taken, and in the ordinary medicinal doses if continued too long, it is apt to cause disturbance of the stomach, gastric pain or spasm, and sometimes severe attacks of intestinal colic. Swallowed very copiously, and even in smaller quantities if concentrated, it produces poisonous effects so much like those resulting from sulphuric acid that it is unnecessary to repeat an account of them. (See *page* 357.) With the nitric acid, however, the inside of the mouth is stained yellowish instead of whitish; and yellow stains on the skin of the face will often serve to distinguish the poison. Two instances have recently occurred of fatal poisoning from inhalation of the fumes of nitric acid, arising from the fall and breaking of a jar containing the acid, as it was carried across a room. Timely efforts to save the patients were made but unavailingly. (*Pharm. Journ. and Trans.*, A.D. 1863, iv. 475.) The antidotes and remedial treatment are absolutely the same as in the case of poisoning from sulphuric acid. When poisoning results from inhalation, as in the cases just referred to, the use of the recently invented atomizer obviously suggests itself. By means of it, a perfectly safe solution of one of the bicarbonated alkalies might be thrown, in the form of spray, into the upper passages, and thus made to neutralize any acid there present, leaving only inflammation to be combated, which would require the copious use of leeches preceded by the lancet. Gaseous ammonia is itself so irritating, that there might be fear of aggravated inflammation from its use.

Mode of Operating. Nitric acid is a direct stimulant to the alimentary mucous membrane, becoming irritant in over-doses. It is probably never absorbed in the acid state; but combines in the stomach and bowels with the albumen, and the salifiable bases which it always encounters there, and in this state of combination may enter the circulation, in order to be thrown off immediately by the kidneys. Now the alkaline salts of nitric acid are remarkably refrigerant and sedative to the circulation when absorbed, especially the nitrates of potassa and soda; so that, as one of these salts will be likely to be formed by the nitric acid in the bowels, we may readily account for the refrigerant effect asserted to be produced by the acid. As to its supposed alterative action, so far as such an effect has been experienced, it may be explained in a somewhat similar manner. Muriatic acid frequently exists in the stomach. It is possible that, by reaction with this, the nitric acid may sometimes generate that peculiar combination called nitromuriatic acid, which undoubtedly has an important alterative action on the system. This view is rendered the more probable, as it is only occasionally that nitric acid is found to exercise the alterative influence ascribed to it; and it is only occasionally that the reactions can occur which produce nitromuriatic acid. We may explain in the same way the reported occurrence of ptyalism in some instances; as one of the admitted characteristic properties of nitromuriatic acid is frequently to act on the gums.

In the concentrated state, nitric acid decomposes the tissues through its chemical affinities, and thus causes the death of the part, acting as an escharotic.

Therapeutic Application. The use of nitric acid as a tonic is very nearly the same as that of sulphuric acid. Like that, it is peculiarly applicable to the *debility of convalescence*, with want of appetite, and a disposition to sweat at nights; though not perhaps equally efficient in correcting excessive perspiration. I have occasionally met with cases of fever, from which the recovery seemed very slow; the pulse remaining rather frequent, especially in the latter part of the day, the tongue somewhat furred, and the appetite feeble or wanting; and this state of things continuing for days with little or no change. Under such circumstances, nitric acid, given in small doses every two or three hours, has seemed to answer an excellent purpose in hastening and confirming the convalescence.

It has also been used with asserted advantage in *fevers generally*, being prescribed partly as a tonic, and partly as a refrigerant in those of feeble action, and as a refrigerant alone, in such as require no supporting treatment; but, in cases of this kind, having had little faith in its peculiar efficacy, I have not been in the habit of using it; and can, therefore, say nothing from experience of its virtues. I have already explained how it is possible that it may produce a refrigerant effect. Dr. Bedford Brown, of Yanceyville, N. C., has found it highly advantageous in the adynamic state of remittent fever, in connection with sulphate of quinia, to which, he thinks, it "certainly added efficacy." He began with three drops every six hours, and gradually increased even to ten drops in cases of peculiar intensity. (*Am. J. of Med. Sci.*, Jan. 1860, p. 49.) Dr. Wm. A. Hammond states, as the result of his treatment of 41 cases of intermittent, 32 by nitric acid, and 9 by sulphate of quinia, that the former was equally successful with the latter. He gave ten drops of the acid three times a day. (*Ibid.*, April, 1861, p. 606.) It had previously been used as an antiperiodic by Drs. E. T. Bailey and Geo. Mendenhall, of Indiana. (*U. S. Dispensatory*, 12th ed.)

Some have supposed it to have an alterative influence on the *liver*, and to be useful in *chronic inflammation of that organ*. Generally it has altogether failed of making any useful impression in such cases, and certainly cannot be relied on. Nevertheless, it may occasionally do good, through the generation of nitromuriatic acid in the primæ viæ.

Of its asserted specific virtues in *secondary syphilis*, *scrofula*, and various eruptive affections characterized by a depraved blood, as *impetigo*, *ecthyma*, *rupia*, etc., I have seen nothing which might not be ascribed to its simple tonic action upon the digestive organs, and to the consequent improvement in sanguification and nutrition. Nevertheless, there may possibly result from its chemical reactions within the system, substances having in some degree the peculiar virtues referred to; and the statements as to its efficiency made by respectable practitioners would tend to confirm this view. It is, however, acknowledged to be inferior to other medicines in the cure of the affections mentioned, and, if used at all, should be so as an adjuvant merely.

In *diarrhœa*, and *dysentery*, and the ordinary forms of *cholera*, it has been highly recommended; and, in the form of what is called *Hope's mixture*, was at one time in great repute. This consisted of nitrous acid, camphor water, and laudanum. Much stress was laid upon the choice of nitrous preferably to nitric acid. I have already shown that this preference was unfounded. I have employed this mixture in the affections above referred to, but generally with little greater effect than could be ascribed to the laudanum and camphor water. The acid often provoked irritation and pain in the stomach or bowels. Nevertheless, there are cases of bowel affections in which the acid appears to do good. I consider it wholly inapplicable to acute cases, with severe pain in the bowels, and febrile symptoms. The circumstances under which it has appeared to me useful, are a certain degree of general debility, without heat of skin, with no considerable pain, and evidences of a feeble or relaxed condition of the mucous membrane, which disables it from resuming its healthful functions. In such a condition, whether the affection be in the early or advanced stage, and whether it have the form of diarrhœa or of dysentery, the combination above referred to may prove useful; but it is, I think, in cases of *diarrhœa* following *cholera infantum* that it has proved most beneficial in my hands. In ordinary cholera morbus, other methods are so uniformly successful, that I have never considered myself justified in omitting them in order to try nitric acid.

Epidemic cholera has also been treated by nitric acid, but I believe with no peculiar success.

In *hooping-cough* it was recommended by Dr. Arnoldi; and Dr. Geo. D. Gibbs considers it as a most efficient remedy. In a treatise by the latter, published in London, A.D. 1854, he states that "it not only arrests the paroxysms, and removes the hoop, but shortens the disease almost as effectually as quinine does intermittent fever." (*Lond. Med. Times and Gaz.*, July, 1854, p. 118.) Dr. Arnoldi adds as much of the acid to water, sweetened with sugar almost to the consistence of syrup, as will give it the sourness of pure lemon-juice. Of this preparation he gives to a child one year old a dessertspoonful every hour, to an adult a tumblerful during the day. It is useless to speculate upon the mode of action of the remedy, till further experience shall have established its efficacy. Hooping-cough is sometimes protracted in consequence of a state of debility into which the patient is apt to fall, and which is relieved by tonics. Thus far nitric acid may no doubt prove useful; but much more is claimed for it by the practitioners above referred to.

Several cases of *spasmodic asthma* very promptly yielded to the use of the acid, in the practice of Dr. T. S. Hopkins, of Bethel, Georgia. Most if not all of the cases were of young children. He gave from three to five drops of the acid three times daily. (*Am. Journ. of Med. Sci.*, N. S., xx. 549.)

As an *antilithic*, the remarks made upon sulphuric acid are precisely applicable to the nitric. It will be remembered that it is in the phosphatic diathesis that the remedy is specially indicated.

As a *local remedy*, nitric acid has been used to stimulate feeble ulcers, to remove the callous edges of the obstinate, and to correct the morbid action of the ill-conditioned and phagedenic. It has also been recently employed, with great asserted advantage, as an application to prolapsed anus and piles.* Sir B. Brodie succeeded in dissolving a phosphatic calculus, by injecting into the bladder, every two or three days, for a time varying from fifteen to thirty minutes, water acidulated with nitric acid, in the proportion of two and a half minims to a fluidounce.

Administration. The *dose* of the officinal acid is from three to seven drops; but, as kept in the shops, it is often of less than the officinal strength; and no precise rule can be given under the circumstances. I have found, however, that the above quantity of the officinal acid makes a large wineglassful of water rather disagreeably sour; and enough, therefore, of any specimen employed should be added to water to produce this effect. In the uncertainty as to the strength of the acid, a small dose should be given at first, to be gradually increased until it produces some sensible effect upon the stomach, a little pain for example, and then to be somewhat diminished. The water may be sweetened, if so preferred by the patient. Special care should be taken to avoid injury to the teeth. (See *Diluted Sulphuric Acid*, page 364.)

As a wash for ulcers, from twenty to forty minims of the strong acid may be added to a pint or a quart of water.

Incompatibles. The acid should not be administered with uncombined metals, alkalies, alkaline earths, or their carbonates, nor with soaps or sulphurets. Caution should always be observed not to drop it into a silver spoon, as it would thus form nitrate of silver, or lunar caustic. It should be administered from a glass or porcelain vessel.

Diluted Nitric Acid (ACIDUM NITRICUM DILUTUM, *U. S.*, *Br.*) is an officinal preparation. The present Pharmacopœia directs three troyounces of the officinal acid (sp. gr. 1.42) to be mixed with sufficient distilled water to make the Diluted Acid measure a pint; but, in order that the preparation may be of uniform strength, the apothecary, if unable to obtain a strong acid of the officinal specific gravity, should make the requisite allowance, and increase the proportion of the acid sufficiently to compensate for its feebleness. This he will be enabled to do by consulting the table of Dr. Ure (see *U. S. Dispensatory*), from which he can learn the quantity of strong acid in any specimen of a given specific gravity. The dose of the diluted acid is from twenty to forty drops, which should be taken in a large proportion of water. The preparation may be applied undiluted, by means of a camel's-hair pencil, to pseudomembranous exudations, and certain indolent and insusceptible ulcers; care being taken not to allow the application to extend beyond the surface affected.

---

* In reference to the surgical use of nitric acid, as an escharotic in piles and prolapsed rectum, see the *Lond. Med. Times and Gaz.*, April, 1853, p. 343; Aug. 1854, p. 184; and Dec. 1855, p. 566.

An *ointment of nitric acid* was formerly officinal; but has been omitted in recent editions of the pharmacopœias. It was made, according to the Dublin process, by melting together a pound of olive oil and four ounces of lard, and adding, upon the commencement of concretion, five and a half drachms of the acid. The resulting ointment, which was yellow and of a firm consistence, was used in cutaneous affections, more especially *porrigo* and *impetigo*.

III. MURIATIC ACID.

ACIDUM MURIATICUM. *U. S.*—ACIDUM HYDROCHLORICUM. *Br.*

Syn.—*Hydrochloric Acid.—Chlorohydric Acid.*

Origin. Muriatic acid was described by Basil Valentine in the fifteenth century. To the older chemists it was known by the name of *spirit of sea-salt;* when better understood, but before its composition had been discovered, it was called *muriatic acid;* at present, chemists usually denominate it *hydrochloric* or *chlorohydric* acid. In the U. S. Pharmacopœia the name of *muriatic acid* has been retained as sufficiently expressive, and best adapted for a medical and pharmaceutical title, until chemists shall adopt one upon which all can unite. The term is applied to the liquid acid obtained by acting upon chloride of sodium with sulphuric acid and a little water, and receiving the hydrochloric acid gas given off in distilled water, which condenses it. The U. S. Pharmacopœia directs that it should have the sp. gr. 1.16.

Properties. Muriatic acid when pure is a colourless liquid, but is often somewhat yellowish as in the shops. It emits a vapour which forms a white cloud in contact with the air. Its smell is strong, pungent, and peculiar; its taste, when diluted, extremely sour. It yields with nitrate of silver a white precipitate, insoluble in nitric acid, but readily dissolved by solution of ammonia. Undiluted, it is corrosive or escharotic.

Effects on the System. So far as regards its action upon the digestive function, it closely resembles sulphuric and nitric acids. Like them, too, when given largely, it produces heat and pain in the stomach, and occasionally disturbs the bowels. In very large quantity, or in a concentrated state, it operates as a corrosive poison, with symptoms similar to those produced by the acids just named; but distinguishable, it is said, by the emission of its peculiar odour from the mouth. At least this effect has been observed, when it has been given in poisonous quantities to the lower animals. The treatment of its poisonous effects is the same as that indicated for the other mineral acids. (See *page* 358.)

Therapeutic Application. Muriatic acid may be used as a tonic to the digestive organs, and indirectly to the system, under the same circumstances as the sulphuric and nitric. From the fact that, mixed with gastric mucus, it will dissolve food, and from the supposition, at one time entertained, that it was an essential agent in the solution of the food in the stomach, the inference seemed reasonable, that it would prove peculiarly useful in facilitating digestion when impaired. It certainly has this effect occasionally; but experience has not proved it to possess any superiority over the other mineral acids. Dr. Paris considers it, when taken in connection with strong infusion of quassia, as one of the best *preventives of the reproduction of worms*, after they have been expelled from the bowels. The acid has been much used in *typhus, malignant scarlatina*, and other fevers of a malignant character, partly under an impression of its antiseptic qualities; and much has been said of its efficiency in these affections. It has also been considered specially useful in *scrofulous* and *syphilitic complaints* and *cutaneous eruptions*. But there may be some doubt whether it acts in all these cases by any other than its tonic powers. It has been used, like the other mineral acids, to correct the phosphatic urinary deposits, and probably acts in a similar manner.

Administration. The dose of the undiluted acid is from five to twenty drops, which may be given in half a tumblerful of sweetened water, and repeated more or less frequently according to the nature of the case; every two or three hours, for example, in acute cases, and two or three times a day in chronic. The same caution should be observed as with the other acids, to prevent injury to the teeth. (See *page* 364.)

To the *incompatibles*, mentioned under nitric acid, may be added, for the muriatic, the soluble salts of silver and lead.

The acid is sometimes used locally. Applied carefully, without dilution, to diphtheritic or pseudomembranous surfaces, it will effectually change the morbid action; but, though strongly recommended for this purpose by Bretonneau, it is probably in no respect superior to the nitrate of silver, while it is less convenient. In ulceration of the mouth and fauces, it has been used, largely diluted, as a mouth-wash or gargle. For this purpose, from one to two fluidrachms may be added to eight fluidounces of water.

There is an officinal *Diluted Muriatic Acid* (ACIDUM MURIATICUM DILUTUM, *U. S.*), containing, according to the directions of the present U. S. Pharmacopœia, four troyounces in a pint of the diluted acid, the remainder being distilled water. The dose is from fifteen to sixty drops.

IV. NITROMURIATIC ACID.

ACIDUM NITROMURIATICUM. *U. S.*

Origin, etc. This combination first attracted notice as a solvent for gold, whence it received the name of *aqua regia*. It is said to have been known to Geber, who lived in the seventh century; but its introduction into medicine dates only from the early part of the present. According to the strict chemical nomenclature of the day, it is named *nitro-chlorohydric*, or *nitro-hydrochloric acid*. It is prepared, according to the present Pharmacopœia, by mixing three troyounces of nitric acid with five troyounces of muriatic acid. When the acids are of sufficient strength, a reaction takes place, which Davy supposed to result in the production of nitrous acid, water, and chlorine. But M. Baudrimont found, upon collecting the vapours rising from the mixture, that they did not consist of chlorine, but of a combination of this element with hyponitrous acid, in the proportion of two equivalents of the former to one of the latter; and he gave the name of *chlorazotic gas* (*chloronitric gas*) to the new compound. Gay-Lussac afterwards investigated the subject, and states as the result of his examination, that two new products are formed, consisting of nitric oxide and chlorine, which may be deemed to have been produced, the one from hyponitrous acid by replacing one equivalent of its oxygen with one of chlorine, the other from nitrous acid by a similar substitution of two equivalents of chlorine for two of oxygen; but Gay-Lussac admits also the evolution of free chlorine. It is seen, therefore, that the compound is no longer a mixture of the nitric and muriatic acids, but of certain new substances, having distinct chemical properties, and probably an entirely different physiological action. As the medicine is officinally prepared, it contains a considerable excess of nitric acid; so that its effects must be those conjointly of that acid and the new products.

It is a fact worthy of particular attention, that nitric and muriatic acids will not react on each other so as to produce the changes above referred to, which are essential to the distinctive medicinal character of the compound, unless in a certain degree of concentration. If the acids employed be weak, they will still remain nitric and muriatic acids in the mixture, and will exercise on the system only the effects of these acids. It is probably from this cause, in part at least, that the disappointment in the effects of nitromuriatic acid has proceeded, which has led to its abandonment by many practitioners, and to the slighting notices of it given by some of the recent English writers. I have used it much, have taken care to guard against this source of failure, and have had every reason to be satisfied of its great efficiency. Indeed, I consider nitromuriatic acid as among our most valuable remedies.

When the strong acids cannot be obtained, reaction may be speedily brought about by the addition of a little sulphuric acid, which probably operates by concentrating the weak acids through its affinity for water. At present there is little occasion for this expedient, as the acids are generally to be found of sufficient strength; but it was not always so; and I have repeatedly made this addition with satisfactory results.

Properties.—When reaction has but partially taken place between the constituents, the colour of the mixture is yellow; but it deepens as the changes go on; and at length, when they are completed, is reddish or orange. The odour closely resembles that of chlorine, but is somewhat different. The taste, upon dilution so as to render the medicine supportable in the mouth, is intensely sour, and somewhat peculiar. Care should be taken that the preparation is kept in a cool place, and excluded from the light.

Effects on the System.—Nitromuriatic acid promotes the appetite, and in other respects operates as a tonic to the digestive function, in the same manner as nitric acid. Like that acid, too, it is irritant to the alimentary mucous membrane in over-doses; and, when swallowed in great excess, or in a concentrated state, acts as a corrosive poison, with the same phenomena as those already described as the result of poisoning by the mineral acids. The antidotes and remedies are also the same. (See *pages* 357–8.)

But this medicine produces other and very important effects upon the system. It is certainly not absorbed precisely as administered; for the nitric acid, which, as before stated, is contained in it in excess, probably never enters the circulation unchanged. There can hardly, however, be a doubt that one or more of the new bodies, resulting from the reaction of the ingredients, is really absorbed. This can scarcely be the chlorine; for the chemical affinities of that element are so powerful, that it could not remain long enough in the primæ viæ, or in contact with the tissues through which it must pass, without satisfying those affinities by union with some other body elementary or compound. May it not be, that the new compound noticed by M. Baudrimont, or one or both of those which offered themselves to Gay-Lussac's research, are capable of absorption, and of producing all the peculiar effects of the medicine upon the blood, and upon the tissues to which they are conveyed by the blood?

An evidence of this action through the circulation is presented in the increased secretion of bile, causing not unfrequently bilious evacuations from the bowels, and in the fact that this occurrence takes place as well from the external as from the internal use of the medicine, proving that it is not merely an irritation propagated from the intestinal mucous membrane through the gall-ducts to the liver. Another evidence of the same kind is the occasional salivation and sore mouth which follow the use of the medicine, whether swallowed or applied to the skin; effects, to the reality of which, though they are by no means constant, I can myself bear witness. Further proofs are offered by the therapeutic influence of the medicine in correcting fetid breath, and modifying the urinary secretion so as to prevent the elimination of oxalate of lime. It probably acts, in both of these instances, by decomposing and destroying substances in the blood which cause these morbid phenomena, while it leaves the normal constitution of that fluid unaffected.

It is in vain to speculate upon the precise method in which these purifying effects are produced. We have not yet light enough to justify even an attempt to form an explanatory theory on the subject; though we may reasonably appeal to facts for proof of the reality of the effects referred to.

Therapeutic Application. Like the mineral acids generally, the nitromuriatic may often be used advantageously in general debility with enfeebled digestion. For the special affections in which it may be thus employed as a tonic to the digestive organs, the reader is referred to the therapeutic applications of sulphuric acid. (See *page* 359.) The condition under which, in these affections, it may be employed preferably to other acids, is when, with the general debility, and that of the stomach in particular, there is conjoined a torpid condition of the liver, as evinced by the want of bile or its deficiency in the feces. In other respects, acting in these cases probably through the excess of the nitric acid it contains, it is identical in its effects with that remedy separately administered.

I am much in the habit of using nitromuriatic acid in certain cases of *diarrhœa*, *chronic enteritis*, and *dysentery*, and find it occasionally extremely useful. The disease, after lingering long under various treatment, speedily begins to amend, and goes on regularly to convalescence, under the use of the remedy, which I generally give combined with an opiate. That the result is not due exclusively to the latter, is proved by the fact that it has been given previously, and in other forms of combination, without any curative effect. The cases referred to are unattended with fever or heat of skin, and are characterized by a relaxed condition of the system, and apparently of the alimentary canal, which appears to indicate a tonic treatment. I am disposed to think, however, that the remedy operates, in these cases, not only as a tonic, but also by an alterative influence on the mucous surface, and perhaps upon the blood, the nature of which is not yet understood.

The applicability of nitromuriatic acid to the treatment of *diseases of the liver* was a beautiful discovery of Dr. N. Scott, of Bombay. That practitioner, having obtained very beneficial effects from nitric acid in hepatic affections, and made known the results of his treatment, and being surprised at a want of coincidence in the experience of other practitioners with his own, was led to make particular inquiries into the cause. He found that the nitre, out of which the acid employed by him in India was prepared, contained a considerable proportion of chloride of sodium, and consequently yielded muriatic acid along with the nitric; so that in fact he had been using nitromuriatic acid in his cases, and not the pure nitric. He was, therefore, induced to try the compound acid, and found his conjecture verified by the result.

Nitromuriatic acid appears to act as a stimulant to the secretory function of the liver, and as an alterative in its morbid conditions, very much in the manner of mercury, though in an inferior degree. It differs from that remedy in being wholly inapplicable to acute inflammatory affections, or high vascular irritation, with active congestion of the organ But *when the secretory function is deficient, or wholly suspended, in consequence of mere torpor or debility of the gland*, nitromuriatic acid acts often very advantageously; and if, with this condition of the liver, there are conjoined considerable general debility, an anemic or otherwise depraved state of the blood, and depression of the digestive function, it should even be preferred to the mercurials, as it tends to repair, instead of aggravating, as the latter remedies too often do, the coincident affections. In *chronic inflammation of the liver*, also, the remedy is peculiarly useful, under the same circumstances. In cases, moreover, in which mercury has been tried without satisfactory results, or insurmountable prejudice exists against it, or idiosyncrasy of the patient forbids its use, nitromuriatic acid should be resorted to as the best substitute. In the *suppurative stage of acute hepatitis*, the same remark is applicable. Of course, in the *jaundice, dropsical affections*, and *general cachectic state of system*, so often associated with, and in great measure dependent on hepatic disease, much good may be expected from the remedy, properly employed, and sufficiently long continued. One practical remark is applicable in all these cases; namely, that nitromuriatic acid and mercury, however apparently coindicated, should never be administered together, at least with any quantity of the mercurial larger than a small fraction of a grain; for there is danger of the production of corrosive sublimate, and, consequently, of all the mischief which that poison is capable of producing. I have been informed, on sufficient authority, of a case of death which speedily followed the joint exhibition of nitromuriatic acid and calomel, with violent pains in the stomach and bowels, vomiting, purging, etc.

As a purifier of the blood, nitromuriatic acid may be used advantageously in depraved states of health, attended with *ulcerative affections of the skin*, or certain eruptions, as *ecthyma, rupia, porrigo*, etc.; in *the purulent infection* consequent on the absorption of degraded and disintegrated pus, and in the somewhat similar condition of the system in *gangrene*. In all these cases, it probably acts jointly by the tonic influence of its acid ingredient on digestion, and the general alterative influence of the portion absorbed.

In the *oxalic lithiasis* it is certainly an admirable remedy. Suggested first, I believe, by the late Dr. Bird, of London, instead of the nitric acid recommended by Dr. Prout, it has come into general use, and often produces the happiest results. I have repeatedly used it in cases characterized by an abundance of oxalate of lime in the urine; and, I believe, in no instance have known it to fail in correcting, or much diminishing that symptom; while, at the same time, the constitutional symptoms have often undergone a similar amelioration.

There is a special morbid condition, which I have occasionally met with, and have for many years been in the habit of combating, by means of this remedy, with the happiest success. I do not know that I can convey an accurate idea of this condition to the reader, but it is sufficiently well characterized to my own observation. There is a failure of the appetite, a slight fur upon the tongue, which, however, remains moist, a tendency to constipation, a cool, moist, and relaxed surface, and a pulse rather feebler, perhaps, than in health, sometimes a little accelerated, but not strikingly abnormal in any way. With these symptoms are frequently conjoined an offensive breath, general languor, and a remarkable and apparently causeless depression of spirits, with perverted feeling, sometimes almost approaching insanity. I have attributed this condition to a depraved state of the blood, dependent probably on defective digestion and assimilation. It may continue for weeks without abatement; but, under the use of nitromuriatic acid, begins to improve in a few days, and, in a period of time varying from two or three weeks to some months, often yields entirely. Since the practice of chemical and microscopical investigation of the urine has come into vogue, circumstances have prevented me from investigating the state of the secretion in this affection unless in a few instances; and, in all of these, oxalate of lime was noticed in the urine.

Administration. The dose of the acid is from two to ten drops, according to its strength. About five drops is a medium dose, which may be given in from two to four fluidounces of sweetened water, and repeated two, three, or four times in twenty-four hours. As the medicine, in large doses, is apt to induce colicky pains, it is best to begin with a small dose, and increase till it evinces some sign of acting. The same caution should be observed as with the other acids, to guard the teeth against injury. Care should be taken, in opening the bottle in which the acid may be contained, to avoid exposing the face to the jet of gaseous vapour, which sometimes suddenly escapes, especially when the bottle has been kept in a warm place, and which may endanger the eyes, if not guarded. When the patient, or a nurse, mixes the acids, particular direction should be given that they should not be dropped into water before they have been mingled, and full time has been allowed for mutual reaction. In fact, it is best that the mixture should be made by the apothecary, and, after sufficient reaction has taken place, should be diluted before being dispensed. I frequently thus prescribe the remedy, directing it to be diluted with camphor water, in such proportion that a tablespoonful of the preparation shall constitute a dose, to be afterwards further diluted by the patient. To this mixture a portion of laudanum may be added, whenever indicated.

The *incompatibles* are so numerous, that the safest plan is to give the acid without other accompaniments than those just mentioned. It should be administered from a wineglass, or by means of some other glass or porcelain instrument, and never from a metallic spoon, especially one of silver.

So far as concerns the effects of the medicine on the liver, it has been thought that its external use is scarcely less efficient than the internal. At least, the two methods may often be advantageously conjoined; or the outward application may be resorted to when the medicine operates offensively on the alimentary canal. It may be employed externally in the form of lotion, footbath, or full bath. For the purpose first mentioned, it may be added to water, in the proportion of two fluidrachms to a pint, and applied by means of a sponge. For a footbath, from one to two fluidounces may be used to the gallon of water; for a bath, about one fluidounce to the same quantity. Both the bath and footbath should be at the temperature of about 96° F., and should be prepared in wooden vessels. The application may be continued from ten to thirty minutes, or till a tingling or pricking sensation begins to be felt in the skin. It may be repeated daily, or twice a day.

V. PHOSPHORIC ACID.

ACIDUM PHOSPHORICUM.

There are three isomeric conditions of phosphoric acid, identical in composition, but differing in their relation to bases, of which one unites with one equivalent, the second with two eqs., and the third with three; and hence they are distinguished by the names of *monobasic*, *bibasic*, and *tribasic phosphoric acid;* water when combined with these being considered in the state of a base. With these preliminary remarks, I must be content with referring to the U. S. Dispensatory (12th ed., p. 51), for the chemistry of this acid. Two forms of phosphoric acid are now officinal, the *glacial*, namely, and the *diluted*, both of which were introduced into the U. S. Pharmacopœia, for the first time, at its late revision.

1. GLACIAL PHOSPHORIC ACID. ACIDUM PHOSPHORICUM GLACIALE. *U. S.*—Syn. *Monobasic Phosphoric Acid. Metaphosphoric Acid.—Phosphate of Water.* This is the first of the three varieties just named, being always combined with one eq. of water, and represented by the formula HO,PO_5; the anhydrous acid consisting of one eq. of phosphorus and five eqs. of oxygen. It results when the product of the combustion of phosphorus is introduced into water; but is commonly obtained from calcined bones, by treating them with sulphuric acid, which produces a superphosphate of lime, dissolving this out by water, adding carbonate of ammonia, and exposing the resulting phosphate of ammonia first to an evaporating heat, and then to calcination, by which the ammonia is driven off, and the glacial acid is left. (*See U. S. D.*) This variety, however, of phosphoric acid is *generally imported*, being seldom made in our chemical laboratories.

The glacial phosphoric acid is a transparent, white or colourless fusible solid, inodorous, [illegible] in water and [illegible]. It is [illegible] tates with [illegible] chloride of bar[illegible] and is distinguished [illegible]

The [illegible] system [illegible] the [illegible] Pharmaco[illegible]

2. DILUTED PHOSPHORIC ACID. [illegible]

Properties. Diluted phosphoric acid is a colourless liquid, without smell, extremely sour, and possessed of strong acid properties. Though much less corrosive, even in a concentrated state, than sulphuric acid, it is yet capable in that state of destroying life. Orfila has seen fatal gastritis produced in a dog by thirty grains of it dissolved in a very little water.

Medical Uses. As a medicine, it has been more used, till of late, on the continent of Europe, particularly Germany, than either in Great Britain or this country. Having never prescribed it, or seen it prescribed, I am not entitled to give an authoritative opinion upon its properties or value as a medicine; but, from all that has been written upon the subject, though some writers claim for it special and extraordinary virtues, there seems to be good reason to believe that it resembles the other acids in its effects, and can do little more than they. It is thought especially to resemble sulphuric acid in tonic virtues, and, though not so energetic, has the advantage that its taste is somewhat more agreeable, and its tendency to produce gastric and intestinal irritation less. It may, therefore, be employed to promote the appetite and invigorate digestion in debilitated states of the system. Scrofulous affections, passive hemorrhages, colliquative sweats, excessive suppuration, low febrile diseases, caries of the bones, ulcerous and eruptive affections with depraved blood, are complaints in which it has been recommended, and in which its tonic properties may have rendered it useful. Its property of dissolving phosphate of lime out of the body has led to its employment in ossification of the heart and blood-vessels, and in cases of phosphatic deposits in the urine, in the hope that it might dissolve the abnormal bony matter, and calculous formations within the body. In the urinary affection, it may operate beneficially in the same manner as sulphuric acid. It has been supposed to possess the power of greatly reducing vital irritability, and has been employed, in reference to this property, in hysteria and convulsive disorders. On the contrary, from an imagined excitant influence over the generative organs, it has been used in impotence in males. As a local application, it has been especially recommended in caries, in which it corrects the fetor, dissolves and aids in the separation of the dead portions of bone, and otherwise favours the healing process. It is said also to have proved beneficial in offensive cancerous ulcers.

It might be supposed that phosphoric acid would occasionally prove useful by supplying a deficiency of phosphorus or the phosphates in the tissues. There can be no doubt that it forms with the salifiable bases it meets with in the alimentary canal, as lime, soda, etc., salts which may enter the circulation, and thus produce all the effects which it has of late been somewhat fashionable to ascribe to the phosphates. But when it is considered that there is always more or less of the phosphates in the blood and in the urine, resulting probably from the disintegration of the tissues, and in part, possibly, from the food taken. It is obvious that it is not the presence of the phosphates that is wanting, but the power of appropriating them. I have never therefore been disposed to ascribe much virtue to the phosphates when used with the object of supplying a supposed deficiency of phosphorus in the nervous tissues, or of phosphate of lime in the bones.

The dose for internal use is [illegible] which should be given largely diluted. For external use the officinal acid may be diluted with nine or ten times its bulk of water.

* * *

VI. CARBONIC ACID WATER.

AQUA ACIDI CARBONICI. U. S.

Syn. *Aerated or Soda Water.—Artificial Mineral Water.*

Preparation.—[illegible] U. S. Pharmacopœia [illegible] gas [illegible]

W[illegible] gas. [illegible]

The [illegible] fountains [illegible] for an [illegible] preserved.

Properties and Effects.—Carbonic acid water is an effervescing sparkling [illegible] pungent acidulous taste, after [illegible] irritation in the fauces. It reddens litmus paper and precipitates lime-water.

From the mode in which it is prepared and kept, it is liable to two impurities, which very much interfere with its beneficial operation. Not unfrequently the fountains or reservoirs containing it are furnished with a leaden tube of exit, so that a portion of the water, drawn at any one time, must have been for a longer or shorter period in contact with lead, and is liable to be more or less impregnated with the carbonate of that metal. Should it be frequently drawn, there will be no appreciable quantity of the salt of lead; but if not, the impregnation may be considerable. The water which has remained over night in the exit pipe often contains it; and I have known of two instances of colica pictonum, induced by the habit of drinking every morning the first draught of the water from the fountain.

Another impregnation is copper, derived from the fountain, which is usually made of that metal. The copper fountains are, it is true, tinned in the interior; but the process is not always well performed, or the tin coating is worn off in spots; and thus it very frequently happens that more or less copper is dissolved. Sometimes the solution is so strong as to be obvious to the taste.

It is highly important, for medical purposes, that the water should be quite free from these impurities. Their presence may easily be detected. If lead is contained in the preparation, it will be evinced by the production of a dark discoloration on the addition of hydrosulphate of ammonia; if copper, by a brown precipitate with ferrocyanide of potassium. This latter test is so delicate, that one part of copper, dissolved in 56,000 parts of the water, may be detected by the reddish tinge it produces.

Medical Effects and Uses. Carbonic acid is at first locally irritant. This is perceived on attempting to inspire the pure gas, when a strong irritant impression is felt in the throat and air-passages, so strong, indeed, that the glottis closes spasmodically, and refuses to admit it unless diluted. Applied to the skin for a short time, it produces a feeling of warmth and tingling or prickling, which is said to be sometimes positively painful. When the strongly impregnated liquid is swallowed, it is often so irritant to the fauces, as with some persons to render it almost impossible to take a large draught of it without interruption. It exercises a similar excitant influence on the stomach itself, and this is probably one cause of its medicinal effects. In other words, it is a gentle gastric stimulant, operating in a manner more analogous to that of the milder aromatics than of any other medicines. It is said to be refrigerant, and to excite perspiration and diuresis. But I believe it owes these effects to the water with which it is taken; and one of its advantages is that, by the gentle stimulation of the acid, it prevents injurious effects from the large draughts of very cold water swallowed with it. I do not think that of itself it is stimulant to the secretions. It is probably not absorbed into the circulation as carbonic acid from the alimentary canal, for the tendencies of the blood are everywhere to give out rather than to take in that substance. Its first stimulant impression appears to be followed, as is known to be the case with the gas locally applied, by a sedative influence on the nervous tissue.

The gently stimulant action of carbonic acid water renders it useful as a tonic in dyspepsia and other states of gastric debility, if not used so largely and so frequently, as on the one hand to produce inflammation of the stomach, and on the other to exhaust its excitability. The dyspeptic patient will find advantage in taking a moderate draught of it twice a day. Another great advantage is the one, already referred to, of obviating too great a depressing effect from cold water, and of rendering it acceptable to the stomach, when it might otherwise prove oppressive, possibly excite gastric spasm, or be rejected. Hence, when heated and perspiring, we may much more safely take a draught of cold carbonic acid water, than an equal amount of equally cold water not similarly protected. Hence, too, in febrile diseases carbonic acid water very cold may be given happily as a refreshing and refrigerating drink, when cold water in the same quantity might oppress the stomach. It thus, too, enables the liquid to act as a diluent, and, by entrance into the circulation, and passing off with the secretions, to relieve febrile excitement.

But the most useful remedial effect of carbonic acid is the relief of nausea and vomiting. There are few means more efficient for this purpose, when the nausea is not dependent on positive inflammation of the stomach. It is one of our very best resources in the [illegible] stomach of fevers. Most frequently, perhaps, the effect of carbonic acid under these circumstances is obtained through the medium of the effervescing draught; because there is usually at the same time an indication for the diaphoretic and refrigerant influence of the citrate of potassa. But the carbonic acid water is [illegible] very efficient. The best method of employing it is to have a number of small bottles each containing about two [illegible] well corked and kept in [illegible] water. The contents of one of these may be taken as wanted every half hour [illegible] and the preparation remains [illegible] successive draughts from one large [illegible] exhausted before the bottle is emptied. [illegible] diseases that may be thus treated [illegible] cholera [illegible] and all other diseases in which the [illegible] is properly gastric and not positively inflammatory.

As a vehicle for saline cathartics and other medicines, it often obviates any nauseating effect from them, and renders them acceptable to the stomach. Carbonic acid water [illegible] excellent menstruum for sulphate of magnesia, citrate of magnesia, or any other of the more soluble saline cathartics, of the citrates of potassa and ammonia as diaphoretics, and of the alkaline carbonates as diuretics and antilithics. It is also sometimes useful as a solvent for substances not soluble in water alone. The carbonate of iron and carbonate of magnesia are soluble to a certain extent in carbonic acid water, which thus offers the means of agreeably administering these substances in solution.

The dose of the preparation is not precise. The patient may, in general, be left to his own discretion; but it is best on the whole to give it in small quantities, as of a wineglassful, repeated frequently, than very largely at once. Seldom more than from four to eight fluidounces should be taken at one draught. It is often advisable to flavour it with some agreeable syrup; as, in febrile cases, with lemon syrup, and in dyspepsia with ginger syrup; but in nausea and vomiting, it is usually more effective when taken alone.

Considerable use has been made of carbonic acid water topically, as a gently stimulant agent. Applied by means of cloths, it has been employed advantageously in cancerous, sloughing, and other ill-conditioned ulcers, of which it relieves the pain, improves the secretions, and checks the gangrenous tendency. Fermenting poultices have been used for the same purpose. They owe their efficacy to the carbonic acid evolved.

Many natural mineral waters contain carbonic acid gas, which adds greatly to their usefulness, by rendering them more palatable and more acceptable to the stomach.

CARBONIC ACID GAS.

Much attention has been recently bestowed on the medical properties and uses of carbonic acid in its pure gaseous form. Towards the close of the last century, it was brought into notice, as an anæsthetic agent, by an experiment of Ingenhousz, who found that a finger, deprived of its cuticle, and introduced into oxygen gas, became more painful; whereas, by immersion in carbonic acid gas, the pain was relieved. Acting upon this hint, several English physicians employed it remedially, injecting it into the rectum in dysentery, and applying it to painful and ill-conditioned ulcers on the surface; and Mr. Ewart, a surgeon of Bath, obtained great benefit from it in cancer of the breast. The direct application, however, of the pure gas seems to have fallen into entire neglect; though it has ever since continued to be employed, in the form of effervescing draughts, for the relief of irritable stomach, and in that of fermenting poultices, for gangrenous ulcers. In 1834, M. Mojon, of Genoa, recommended the injection of the gas into the vagina in dysmenorrhœa, and other painful affections of the uterus; and the practice seems to have been imitated by other Italian physicians. About the same time, it was employed at certain mineral springs in Germany and France, in the form of air-bath and of the air-douche, for rheumatic pains and various other affections; the gas being used as it issued from the natural fountains. But it is to Sir J. Y. Simpson, of Edinburgh, that we are mainly indebted for the revival of this remedy, and the much more extended use now made of it. Having seen a notice of its efficacy in a case of uterine disease, under the care of Dr. Rossi, of Italy, he was induced to give it a trial, and made his experience with it public, in an essay upon the subject, written, in 1856, for the New York Academy of Medicine.

Properties. When a stream of carbonic acid gas is directed upon a sensitive surface, as of the mucous membranes, or the skin denuded of the cuticle, it produces at first an irritation, variable in degree according to the sensitiveness of the surface, and sometimes very painful, especially in the conjunctiva, which, it is said, cannot support the application longer than 4 or 5 seconds. In the nasal passages it produces an effect analogous to that of ammonia, and, when the attempt is made to inhale it, either unmixed or diluted with 50 per cent. or less of atmospheric air, it causes so much irritation in the larynx that the glottis closes spasmodically, and its entrance into the lungs is prevented. (Herpin, *Ann. de Thérap.*, 1859, p. 60.) This property of carbonic acid gas has been long known; and I once convinced myself of its reality by cautiously attempting to inhale the air over the surface of the fermenting liquid, in a large brewers' vat. It has been denied by Sir J. Y. Simpson, probably from the circumstance that, in the cases in which he applied the gas to the air-passages, it was much diluted with atmospheric air. (See *Braithwaite's Retrospect*, xxxviii. p. 260.) When mixed with 80 or 90 per cent. of atmospheric air, it is inhaled readily, and without inconvenience. Its first irritant impression on the part to which it is applied is soon followed by a sedative effect upon the nervous tissue, by which pain, if present, is often entirely relieved. Even ordinary sensation is after a time much diminished, as shown by an experiment of Dr. T. A. Demmé, of Philadelphia, who immersed his naked arm in the gas, and, after ten minutes, found the skin so much benumbed that it could be violently pinched without causing pain. (*Med. and Surg. Reporter*, Feb. 26, 1859, p. 380.) When inhaled, in the diluted state, the gas is said to accelerate the circulation, though acting as a sedative to the nerves. After a short continuance of inhalation, it causes a state of somnolence and anæsthesia, which, according to Messrs. Faure and Ozanan, who experimented with it on the lower animals, may be kept up, without danger to life, for 10, 20, or even 30 minutes, so as to give ample time for the performance of any ordinary surgical operation. Though, in its concentrated state, it causes speedy suffocation by excluding air from the lungs, yet, when mixed with so large a proportion of common air as to be readily inhaled, it is said not to occasion sudden death, but to induce insensibility gradually, and without any violent symptoms (Herpin, *Ann. de Thérap.*, *loc. cit.*) If these results should be satisfactorily confirmed by experiment, carbonic acid gas would be a safer surgical anæsthetic than chloroform.

Dr. Cl. Bernard, of Paris, has observed that the injection of carbonic acid into the vagina is not unfrequently attended with constitutional effects, similar to those produced by its inhalation. The symptoms are headache, giddiness, abnormal sounds in the ear, nausea, somnolence, languor and prostration, and even involuntary discharges of urine; and he has sometimes found them so threatening as to preclude the use of the remedy. He noticed the effect as well in cases in which the surface of the vagina retained its integrity, as in those in which there was ulceration.

From a series of experiments by MM. Ch. Leconte and J. Demarquay, of Paris, on the effect of gases injected into the subcutaneous cellular or areolar tissue, or cavity of the peritoneum, it has been satisfactorily determined that carbonic acid thus injected produces no injurious effect; being absorbed in forty-five minutes; and that, consequently, no hesitation need be felt in applying it in this way, when from any cause indicated. (*Arch. Gén.*, Oct. 1859, p. 568.) Now, as carbonic acid gas has proved anæsthetic under various circumstances of application, it would probably be found so if injected into the areolar tissue. At least it might be worth the trial, in cases of obstinate local pains which have resisted other anæsthetics, or in which there may be some objection to their use. MM. Leconte and Demarquay also ascertained that this gas, brought into contact with divided tendons, facilitated their union.

Uses. The affections in which the gas has been found most useful, when topically applied, are *painful states of the uterus and vagina*, with or without ulceration. Great relief is afforded in cancerous cases; and sometimes ulcers of this character, at the neck of the womb, are said to have been much benefited, and even healed under its influence. (Cl. Bernard, *loc. cit.*) The anodyne influence of the gas is sometimes preceded by severe burning pain, which is diffused through the pelvis; and this is said occasionally to be so inconvenient as to prevent the use of the remedy. But in general the uneasiness, if produced, soon subsides, and is followed by the anæsthetic effect. The application may be repeated twice or three times daily; and each time may continue fifteen minutes or longer; but should always be suspended on the occurrence of constitutional symptoms.

Much relief is also asserted to have been obtained from the remedy in *irritable states of the bladder*, with painful micturition. It is injected through the urethra, by means of a double catheter, by which injurious accumulation and distension of the viscus are prevented. Sometimes, as from injections into the vagina, the pain is very severe. According to Dr. Robert Johns, of Ireland, who has had considerable experience with the remedy, it should not be repeated, as a general rule, oftener than once daily, and the bladder should be well washed out with warm water before the application. (See *Am. Journ. of Med. Sci.*, N. S., xxxvi 561.)

In the *tenesmus of dysentery* relief may be expected from the injection of carbonic acid gas into the bowels: and it has been already stated that this use of the remedy was made before the commencement of the present century.

The same is true of its employment in *external cancer* and other ill-conditioned ulcers; and Sir J. Y. Simpson recommends it in wounds and burns. It is said not only to relieve the pain of these ulcers, but to promote their cure.

In the *photophobia* attendant upon scrofulous disease of the conjunctiva, a stream of the gas properly diluted has been found useful; but its intensely irritating effect, when too concentrated, must be borne in mind. Good might be expected from it in that not uncommon, and very painful affection, in which exposure to light produces great suffering, from an over-sensitive state of the retina. In a case of *severe earache*, Dr. Demmé obtained very favourable effects from the introduction of the gas into the external meatus. (*Med. and Surg. Reporter*, *loc. cit.*)

Employed, in a much diluted state, by inhalation, it is said to have proved useful in *chronic bronchitis*, *laryngitis*, and *pharyngitis*, and in *asthma* and *irritable cough*. In this way it has been employed, to a considerable extent, by Bischoff and others in Germany; and, as asserted, without unpleasant effects. It is not, however, considered applicable to acute inflammation of the air-passages, or to phthisis. (See *Am. Journ. of Med. Sci.*, April, 1859, p. 543.) Should the remedy be used by inhalation, its application should be watched by skilful persons, and the danger of fatal asphyxia be most carefully guarded against. The physician could not be held unaccountable should serious consequences occur, either through his own carelessness, or the ignorance of those to whom he may entrust the use of the remedy.

Mode of Application. The most convenient method of applying the gas, is by means of a flexible caoutchouc or gutta percha tube, proceeding from a bottle in which it is generated. A Wolfe's bottle may be used having three tubulures, into one of which the exit tube is inserted, in another a safety tube with its lower end beneath the surface of liquid in the bottle, and in the third a stopper removable at pleasure. A mixture of five drachms of bicarbonate of soda and four of bisulphate of potassa, in the form of powder, is first introduced, and, when the instrument is to be used, water is poured in sufficient to cover them. Sir J. Y. Simpson uses eight drachms of crystallized bicarbonate of soda, six drachms of crystallized tartaric acid, and four or five ounces of water. When the evolution of the gas begins to slacken, it may be increased by shaking the bottle.

2. *Mineral Tonics Acting on the System generally, through its Vital Properties.*

It is at present no longer doubted that the medicines belonging to this subdivision enter the circulation, and thus come into contact with all the tissues. They operate primarily on the alimentary mucous membrane, in a manner closely analogous to that of the mineral acids; that is, they moderately stimulate or excite the function of the membrane, or, in other words, act as tonics. But they are all, moreover, somewhat astringent, causing a contraction of the tissues, like alum or acetate of lead, though in a less degree; for a very energetic contraction would interfere with the functions of the membrane, and thus prevent the proper tonic effect. It is highly probable that they operate, in a manner precisely analogous, upon the various tissues of the body which they reach through the blood. Producing a slight increase of the vital cohesion of the molecules of the tissues, they give them a greater power, while, by a gentle excitation, they call this power into a somewhat higher exercise. But, while thus generally tonic and astringent, they are disposed to act more especially upon the nervous centres; or, to speak more precisely, the organized nervous substance of these centres seems to be peculiarly susceptible to be impressed by them, and to take on, under their influence, a condition of greater firmness or compactness, which enables them, if previously weakened, to perform their proper function more efficiently. Here we have the secret of one of the most important therapeutic effects of this set of tonics; that, namely, of controlling the irritability of the nervous centres, and thus obviating various nervous disorders, and especially muscular spasm. From their influence in this way, they have not unfrequently been considered as antispasmodic, and been so denominated. Spasm, as well as most other irregular nervous phenomena, depends upon a disturbance in the nervous centres, produced generally from some source extraneous to themselves. The more movable or excitable these centres are, the more liable will they be to give rise to these irregular phenomena under irritating influence. Now the tonics here referred to, by increasing the vital cohesion of their molecules, and rendering their structure firmer, enable them better to resist disturbing causes; at the same time supporting due action in them by a gentle stimulation. The disordered phenomena cease; and, by a sufficient persistence in the use of the remedy, the centres may acquire a permanent capacity of resistance, which may lead to a permanent cure. Hence, it is in the various nervous diseases, such as hysteria, chorea, and epilepsy, that these tonics have acquired the highest reputation, and are most extensively used.

Some suppose that they act by entering into chemical combination with the constituents of the tissue, and thus forming a part of the organization itself; and that their effects are to be explained by the new qualities which the tissues acquire through this change of structure. They support this opinion by the fact, that the metallic ingredient of these medicines is found in the very substance of the organs, from which it can be separated after death, supposing the patient to have died while under their influence. But this is no proof whatever, and scarcely even in any degree confirmatory of the notion of a chemical union. The metal may be in the capillaries of the organ; it may be deposited in the very substance of the tissue; it may even be there combined with some organic principle derived from the blood or from the tissue; but even admitting all this, it does not follow that it is chemically combined with the constituents of the tissue in their organized state; and it is not easy to conceive how a foreign body, thus thrust into the constitution of the nucleus or cell, which performs the office of the tissue, would enable it to perform that office more effectively. We may conceive that a metallic substance may possibly enter into such a union; but it would be to impair, not to improve the function; it would be to produce the effects of a poison, and not those of a remedy. Indeed, it is not improbable that some metallic poisons operate in this way; but more positive proof must be adduced, before we can admit that medicines produce their curative effect through such a combination, and especially medicines whose immediate operation is to improve and to invigorate.

I. SILVER.

ARGENTUM. *U. S.*

REFINED SILVER. *Br. Appendix.*

Metallic silver is quite inert, and may lie for a long time in the alimentary canal without sensible effect. It is only in chemical combination that it becomes efficient. As all the constitutional effects of its preparations can be obtained by the exhibition of the nitrate, and as this is generally preferred in practice, it may conveniently represent the metal in its relations to the system at large; and all that it is necessary to say, in reference to the operation and uses of silver as a medicine, may be included in our consideration of that salt. Afterwards, nothing need be noticed, in relation to the other preparations, except what may be peculiar to them severally.

NITRATE OF SILVER.—ARGENTI NITRAS. *U. S.*, *Br.*—*Lunar Caustic.*

Origin. This salt has been known since the times of Geber, who described the mode of preparing it. I propose to treat of it, in this place, solely in reference to its internal use. As an external remedy, it is among the most valuable; but the consideration of it, in this capacity, belongs to another part of the work. (See *Escharotics* and *Protectives.*) It is kept in two forms; one, that of cylindrical sticks, adapted for topical use, and frequently called *lunar caustic;* the second, that of crystals, which are preferred when the medicine is to be given internally. It is to the latter that the following remarks apply.

The crystals of nitrate of silver are prepared by dissolving silver in nitric acid with a little water, and then evaporating, so that crystallization may take place upon the cooling of the liquid. They should be kept in well-stopped bottles, from the interior of which everything organic should be excluded.

Composition. Crystallized nitrate of silver consists of one equivalent of nitric acid and one of protoxide of silver, without water of crystallization.

Properties. The crystals are colourless, transparent, and in the form of rhomboidal plates. They are inodorous, but of a strong, bitter, metallic, peculiar, extremely disagreeable, and adhesive taste. Water and alcohol dissolve them freely, especially the former, which takes up its own weight of the salt. At a moderate heat they melt, and at a strong heat are decomposed. In contact with the smallest portion of organic matter, they blacken on exposure to light; but they remain unchanged, even by the sun's rays, in the entire absence of such matter. Their solution in pure distilled water is similarly unaffected by sunlight, unless organic matter is present, in which case it is darkened. The change of colour is owing to a partial reduction of the silver.

Incompatibles. Nitrate of silver is decomposed, with the formation of insoluble products, or such as are but slightly soluble, by the alkalies, alkaline earths, their carbonates, and soap; by sulphuric, muriatic, hydriodic, phosphoric, hydrosulphuric, and tartaric acids, and all the soluble salts formed by the reaction of these acids with salifiable bases, consequently by the soluble sulphates, muriates, phosphates, tartrates, chlorides, iodides, and sulphurets; and by astringent vegetable infusions, in consequence of their tannic acid. With albumen and fibrin it unites, forming compounds insoluble in water; but it is a fact of some importance, in explanation of the operation of the salt on the system, that the albuminate of the nitrate of silver thus formed is soluble in an excess of albumen. Of like significance is also the fact, that the insoluble chloride of silver, which is formed whenever the nitrate comes into contact with muriatic acid or a soluble chloride, is rendered soluble by an excess of chloride of sodium or potassium.*

In consequence of the great number of substances which decompose the nitrate, or combine with it, and the constant presence in the stomach of one or more of these substances, especially albumen, muriatic acid, or a chloride, it is scarcely possible that it can long retain its integrity after having been swallowed; though it may do so sufficiently long to exert a direct influence on the mucous coat. That it should enter the small intestines as nitrate of silver, appears to me to be clearly impossible, unless swallowed in quantities so large as to be poisonous, or unless so incorporated with other substances in the form of pill, that, in this shape, it may pass through the stomach before the pill is broken up, and its interior exposed to the reagents there existing.

Effects on the System. Locally, nitrate of silver is powerfully irritant, and, in a concentrated state, acts as an escharotic by combining with the albuminous matter of the tissues, and thus disorganizing them. When in contact with the mucous membranes, with ulcers, or with the skin deprived of the cuticle, it combines with the albumen of the secreted matters, and often with that of the tissue itself, forming a white and insoluble compound, which covers the surface; and this happens as well in the gastric and intestinal mucous membranes, as in those visible from without. Applied to the skin, it soon produces a black stain, in consequence of the partial reduction of the silver by reaction with the cuticle. This black stain usually remains until the cuticle separates, either gradually, or at once completely, as in vesication. It may be removed, however, by applying to the spot the tincture of iodine, and following this with a solution of hyposulphite of soda; or by the similar application of a solution of cyanide or of iodo-cyanide of potassium. (*Journ. de Pharm.*, Nov. 1865, p. 414.) These remarks, in reference to the local effects of nitrate of silver, will be extended in a subsequent account of the escharotic and protective operation of the salt. At present, they seemed necessary to explain the effects of the medicine upon the stomach.

In very small doses, repeated two or three times a day, nitrate of silver produces no other observable effects than those of a gentle *tonic* and *astringent;* as improved appetite, invigorated digestion, and perhaps a tendency to costiveness. Taken more largely, it causes warmth of stomach, and some gastric uneasiness, indicating an irritant action, which, upon a still further increase of the quantity, is evinced by gastric pains, sometimes nausea and vomiting, and occasionally also by griping pains in the bowels, with either diarrhœa or constipation. As to the degree of irritant effect, much depends on the mode of administration, and the condition of the stomach at the time. It has been repeatedly observed that, in the form of pill, large doses produce little irritation; while a smaller quantity will violently irritate, if given in solution. Dr. Powell found that he could sometimes give fifteen grains in pill, while five grains in solution could rarely be borne by the stomach. (*Med.-chir. Trans.*, ix. 238.) The result is obviously owing, in the instance of the solution, to the whole quantity being brought at once into contact with the surface of the stomach, before time has been allowed for decomposition; while, in the pilular form, dissolving gradually, it acts also gradually, and is more liable to decomposition before it can act at all. When the stomach is full of food, the medicine would be much more exposed to decomposing reagencies than when it is empty, and would consequently be less likely to irritate; for all the insoluble substances resulting from the chemical changes of the nitrate in the stomach are much less irritant than the salt itself. Thus, the chloride of silver, which must be among the most common products, may be given in large doses, without observable effect.

---

* Some doubt is thrown upon the uniform occurrence of the chemical reaction here referred to, by an experiment of Professor Procter, performed at my request. A drop of solution of nitrate of silver was made to fall into a solution of chloride of sodium, and produced a precipitate; yet, after long contact of this precipitate with the supernatant solution, the latter, when filtered off, gave no evidence of the presence of silver when applied to bright copper, and touched with bright iron; and the taste was purely saline.

How far nitrate of silver would operate as a deadly poison, in excessive amount in the human subject, is left very much to inference; for few cases of acute and fatal poisoning from this substance have been recorded. Boerhaave mentions the case of a pharmaceutical student, who, having swallowed a portion of lunar caustic, died from gangrene of the first passages. But this is the only case of the kind that I have met with in the books. In the *Bulletin Générale de Thérap.* (Sept. 1839), the case of a young man is related, who, after having taken a large quantity of the salt in solution, an ounce, according to his own account after recovery, was carried to the Hospital St. Louis, in Paris, quite insensible in all parts of the body, with convulsive movements of the face and upper limbs, jaws firmly closed, eyes rolled up, and pupils dilated and insensible to light. Common salt was given freely, and afterwards emollient drinks. When sensibility began to return, the patient suffered from violent epigastric pains. He ultimately recovered without serious consequences. The effects upon the nervous system may have been sympathetic with those upon the stomach, which was, no doubt, intensely irritated. (See *Am. Journ. of Med. Sci.*, N. S., xxvi. 239.) Orfila found that from twenty to thirty-six grains, introduced into the stomach of a dog, caused death with the phenomena of corrosive poisoning, and that ulceration in the alimentary canal was produced. The fact probably is, that large doses may be borne without immediately fatal consequences, partly from the rapid chemical change which the salt undergoes, and partly from its superficial caustic operation, by which an extremely thin layer of epithelium is disorganized, and, forming with it an impermeable film, protects the deeper and more vital parts of the membrane from destruction. But, admitting this, it must be allowed that a frequent repetition of these large doses might gradually corrode into the deeper structure, and death ensue at last from the slow and continued operation of the poison. Esquirol mentions a case, in which nitrate of silver was given freely during a period of eighteen months, at the end of which time the patient died, and the stomach was found destitute of the mucous coat over one-half of the inner surface, with several points of corrosion to the peritoneal coat.

Nitrate of silver, therefore, must be ranked among the corrosive poisons. In acute cases of its poisonous operation, the treatment should consist in the use of common salt, or, if this is wanting, of the white of eggs, and a thorough washing out of the stomach by diluent drinks, or other means if necessary. Opiates should afterwards be administered, in the form of enema, to quiet irritation; and the resulting inflammation must be treated on general principles; care being taken not to exhaust the patient by too copious depletion.

Hitherto I have considered only the local operation of the medicine on the alimentary canal. It acts also on the system at large, through the circulation. Of its absorption, or rather of the absorption of the metal in one form or another, there can be no reasonable doubt. Leaving out of view the statements made as to the discovery of metallic silver in the pancreas after death, we have Orfila's declaration that he has found it in the liver of animals to which the nitrate has been administered for some time (see *Lond. Med. Times and Gaz.*, March, 1852, p. 279); and, in addition to this, the indisputable evidence of the discoloration of skin produced by it. In any dose in which it is ordinarily given, its physiological influence upon the general functions is not striking. There may possibly be some increase in the frequency or force of the pulse, and the general temperature; but these results are much less observable than from the more powerful of the vegetable tonics. Salivation is said to have been sometimes produced, and writers speak of an eruption upon the skin; but I am not certain that I have witnessed either. One effect, however, is very striking. When the medicine is given in large doses, and long persevered with, a darkening of the skin is sometimes produced, which gradually deepens, till the whole surface of the body assumes a bluish-slate colour, extremely disagreeable to the eye, as totally differing from any natural tint. The discoloration is deepest in the parts exposed to light; but is said also to have been observed in the interior tissues, and in one instance to have pervaded the whole body; though this last statement may be considered as wanting confirmation. It is asserted that, in many instances, it does no until months after the medicine has been discontinued, and its favourable effects experienced. (Sigmund, *London Lancet*, March 31, 1838.) In connection with this fact, may be mentioned the detection by Orfila of silver in the liver of animals, to which the nitrate had been given, six months after its administration, showing that it is apt to become fixed in the tissues. In seven months, however, it had disappeared, and he could find no evidence of its existence in any part of the body. (*Lond. Med. Times and Gaz.*, March, 1852, p. 279.) So far as any inference can be drawn from this fact, it is that a patient cannot be considered free from the danger of discoloration in less than seven months after the omission of the medicine. The discoloration is generally permanent; but is said to have in some instances diminished with time, or under the operation of certain remedial measures. The seat of it is the true skin; for it remains unaffected when the cuticle is removed by a blister. The obvious explanation of the phenomenon is, that the preparation of silver circulating with the blood, when it enters the tissue of the true skin, and is thus exposed more or less to exterior influences, as of light and the air, undergoes decomposition, with the deposition of the partially reduced metal, probably in the state of a suboxide. This being insoluble in the blood, or in any liquid which the parts can generate, remains unabsorbed in the tissue. Happily, before the skin begins to exhibit this hue, a similar dark discoloration usually appears upon the gums and tongue and in the fauces, and serves, if observed, to put the practitioner upon his guard. It is said that the discoloration has disappeared under a steady course of cream of tartar. Dr. Pereira states, in his work on Materia Medica (3d ed., *page* 886), that he has been informed of a case in which washes of dilute nitric acid diminished it. Iodide of potassium has been proposed as a remedy; but has proved ineffectual.

From what has been already said of the facility with which nitrate of silver is either decomposed, or otherwise rendered insoluble by chemical reaction, it is highly improbable that it ever enters the circulation without change. There are, however, two known states of combination, in which the metal may possibly be absorbed when the nitrate is administered. One of these is in the compound of nitrate of silver with albumen, which is soluble in an excess of albumen, and consequently in the blood, and the other in the double compound of chloride of silver and sodium, which is said to be soluble in water. (See *pages* 390–1.) As the albuminate undergoes the darkening process out of the body on exposure, it is highly probable that it undergoes the same change in the tissue of the skin, with a less degree of the same exposure.

Therapeutic Application. Besides the uses of the nitrate as an external remedy, which will be noticed elsewhere, it is employed for two distinct purposes; the one, for its direct influence on the alimentary mucous membrane, the other, for its effects upon the system at large through the circulation.

1. For its influence on the stomach and bowels, it might be employed, in minute doses, as a tonic, in debilitated states of their functions; but other remedies answer the indications so much more conveniently and effectively, that it is very seldom used for this special purpose. Still, as it has been supposed to exercise a peculiar influence over the nervous tissue, it has been recommended in certain painful affections sometimes dependent on dyspepsia, as gastrodynia and pyrosis; and it has been found useful in morbid sensitiveness of the stomach. But it is vastly more beneficial, given rather freely, through its alterative action upon the mucous membrane in a state of chronic inflammation or ulceration; and has been strenuously recommended even in active irritation or acute inflammation of the same tissue.

In *chronic gastritis* of the worst kind, I know of no remedy so effectual as nitrate of silver. Recommended originally, so far as I am aware, by Dr. Hudson, of Dublin, in this affection, it has been employed by me habitually since the first published notice, and with the happiest effects in most obstinate cases. I have not been in the habit of using it in mild cases, which yield readily to a regulated diet, with other suitable hygienic measures, and with little aid from medicine; but, in those severe and obstinate forms of the affection, which have set all ordinary means at defiance, I have found it a most valuable resource. The cases in which it has appeared to me to do most good are those attended with incessant vomiting of food, and often with a smooth dryish tongue, apparently destitute of the papillary structure. I have used it, too, whenever I suspected the existence of ulcers in the stomach. One case of yeasty vomiting, of a most obstinate character, and probably dependent on an ulcer near the pylorus, yielded in the course of two or three months to this remedy. One most striking instance, in which I have little doubt that it was the means of saving life, was that of a female patient in the Pennsylvania Hospital, who had been reduced to the last degree of emaciation and debility, and whose death I was looking for from hour to hour. The stomach had long refused to retain food, and the slightest nutriment induced vomiting. I directed that nothing whatever should be taken into the stomach, except a little cold water, and pills of nitrate of silver with opium, repeated three or four times a day; life being sustained by the injection of rich soups with laudanum into the bowels. The vomiting ceased under this treatment; in a few days a disposition for food returned, which was very cautiously indulged; and the patient went on gradually improving, until her health was perfectly re-established after many months of illness. I believe the remedy acts, in these cases, very much as it does upon the visible mucous surfaces when inflamed. Combining with the outer layer of the epithelium, or of the ulcerated surface, it forms a thin coating, which protects the diseased tissue beneath from irritating matters in the stomach, whether derived from its own secretion or from without, and at the same time, by its astringent and tonic properties, imparts a healthy contraction and tone to the expanded vessels. To produce this effect, it must be in the state of the nitrate. The oxide or the chloride will not at all answer as a substitute. Hence the importance of giving the medicine upon an empty stomach, when it will be less likely to encounter decomposing substances, and will thus be enabled to exert its full influence on the diseased membrane. In these cases, I have never administered large doses of the salt. Beginning with one-quarter or one-third of a grain, combined with from an eighth to half of a grain of opium, repeated three or four times a day, I have very gradually increased, if the symptoms otherwise refused to yield, up to one grain at each dose; but have never exceeded that quantity.

In *chronic enteritis*, also, great benefit is said to have accrued from the nitrate of silver; though, in the trials I have made with it, the results have been much less favourable than in the gastric cases. It probably seldom enters the small intestines, or at least penetrates far into them, without being decomposed, and thus rendered unable to act on the surface of the bowel in the method above referred to. In ulcerative affections and chronic inflammation of the small intestines, it has appeared to me less effective than sulphate of copper. Nevertheless, much testimony might be adduced in its favour, not only in chronic, but even in acute inflammation of the alimentary mucous membrane.

Trousseau strongly commends its use in *acute dysentery*, giving half a grain of the nitrate of silver, and the same quantity of nitre, made into a pill with starch, repeated every half hour till it begins to purge; at the same time administering, twice a day, an enema composed of a pint of distilled water holding from three to ten grains of the salt of silver in solution. (Trousseau et Pidoux, *Traité de Thérap.*, 4e ed., i. 354.) The latter part of the treatment, that, namely, by injection into the rectum, has been imitated with great asserted success in some severe cases of the disease; though the measure has failed in many others. Of the use of nitrate of silver by the mouth, in this complaint, I have had no experience.

The same practitioner has found the medicine very useful in *infantile diarrhœa*. In cases attended with tormina, and glairy or bloody stools, he gives, morning and evening, an enema consisting of eight ounces of distilled water with one or two grains of the nitrate, according to the age; in other cases, characterized by nausea, and serous, green, or lienteric passages, he administers by the mouth from the twentieth to the fifth of a grain dissolved in sweetened water. (*Ibid.*, p. 355.) The same practice has been employed with success in our indigenous *cholera in-*

fantum, when there was good reason to suspect the existence of ulceration of the bowels; and it is certainly among the measures to which the prudent practitioner would be justified in resorting, in obstinate cases of the disease.

By M. Boudin, of Marseilles, the nitrate was recommended so long since as the year 1836 (*Gazette Méd.*, No. 51, 1836), in enteric or typhoid fever, with a view to its curative influence upon the intestinal ulceration of that affection. He gave it either by the mouth or by the rectum, according as the disease appeared to be seated higher or lower in the alimentary canal; and sometimes he united both methods. He administered from a quarter to half a grain by the mouth, in the form of pill, and three or four grains, by enema, night and morning, dissolved in six fluidounces of water. This practice has been imitated by other physicians, but has not been generally adopted. I entertain strong doubts of its efficacy; as I do not believe that the nitrate, when swallowed, will reach the seat of the local disease unchanged; and they who are familiar with the position of the ulcerated surfaces, extending often throughout the whole length of the ileum, would scarcely admit that six ounces of fluid, thrown into the rectum of an adult, would come in contact with them.

In the *diarrhœa of phthisis* the medicine has been used with supposed advantage; but experience has not proved it to be more efficacious in this affection than other medicines habitually employed.

The late Dr. J. F. Peebles, of Virginia, found it remarkably efficient in certain cases of *jaundice* connected with an irritated condition of the stomach and small intestines. He gave from three-quarters of a grain to a grain twice a day, on an empty stomach. (*Am. Journ. of Med. Sci.*, N. S., xviii. 59.)

In reference to the cathartic effect which the nitrate of silver sometimes produces, it was recommended by Boerhaave in *dropsy;* and the medicine is said to have been used advantageously in *worms;* but these applications of it are now seldom or never made.

2. For its effects upon the system at large, nitrate of silver has been employed chiefly in *nervous affections*. In some of these it has been carried to an enormous extent, with the effect probably sometimes of seriously injuring the coats of the stomach, and, in not a few instances, three of which at least have come under my own observation, of producing the indelible discoloration of the skin already described. Nor does this excessive use of the medicine, probably, contribute to the end in view. When given largely, the very irritation of the mucous membrane induced must interfere to some extent with its absorption; and by far the largest proportion is converted into chloride of silver, and passes out with the feces in this state, as proved by the experiments of Dr. Heller. In one instance, a boy aged thirteen took twelve grains daily for three months, without any effect on the system, or discoloration of

the skin; and no trace of silver could be discovered in the blood or the urine; while the whole amount of the metal was found in the evacuations from the bowels. (See *Am. Journ. of Med. Sci.*, N. S., xii. 476.) Nevertheless, that the silver does occasionally enter the circulation is, I think, certain; and it may be presumed to do so generally, though in minute quantities. As the absorption depends upon the solubility of the compound of silver formed in the bowels, and as this probably depends on the presence of an excess of albumen or an alkaline chloride in the alimentary canal, the less the amount of the nitrate given, the greater will be the excess of the solvent agents, and the consequent probability of its absorption. The practical inference from these views is, that the physician should limit himself to moderate doses of the medicine, as being at once safer, and likely to prove not less effectual. I have before endeavoured to explain the nature of the action, by which this medicine, and others belonging to the same subdivision, prove useful in nervous diseases. (See *page* 388.) It will be sufficient to repeat, in this place, that the silver probably acts by increasing the vital power of resistance of the nervous centres to irritant influences, and thus preventing the effects of their irritation, as exhibited in spasms and other irregular movements, and in neuralgic pain. The long period during which, according to the experiments of Orfila before referred to, silver continues to adhere to the tissues after its administration has been omitted, may serve in some measure to explain the permanency of its effects in nervous diseases.

Epilepsy is that one of the nervous affections in which the nitrate of silver has been given most frequently, and in the treatment of which it has the highest reputation. It is certainly among the remedies which have proved most effectual, so far as testimony can avail to decide the question. Every one knows that epilepsy, from the very nature of its sustaining cause, is often quite incurable. That the nitrate of silver, therefore, should very frequently fail, is nothing more than might be expected. The great obstacle to its general use is its liability to cause discoloration of the skin, which is even more objectionable to most persons than the disease itself. The physician, dreading the responsibility of such a result, if he employ the remedy at all, is apt to do so inefficiently; either using it in too small a quantity, or not continuing it sufficiently long. Upon this point, however, he should always guard himself, by informing the patient or his friends of the possible result, and leaving the decision with them. The risk of the discoloration may be considered as extremely small, when proper precautions are taken. These will be mentioned.

Other nervous affections, in the treatment of which nitrate of silver has enjoyed considerable reputation, are *chorea* and *angina pectoris*. The former disease, however, is so readily curable by other less objectionable remedies, that it would not be justifiable to expose the patient to the risk, however small, of the cutaneous discoloration. But in angina pectoris, as in the cases of epilepsy, the choice may well be left to the patient; though the chances of a cure from the remedy are so slight, that little encouragement should be offered. To its use in *hysteria*, *asthma*, and *pertussis*, in which it might be considered as indicated by its influence on the nervous centres, the liability above alluded to should be deemed an all-sufficient objection.

A few years since it was employed by Wunderlich, with remarkable success, in a disease now known as *locomotor ataxy;* and MM. Vulpian and Charcot have subsequently ascertained that, given in small doses, rarely exceeding half a grain in the day, it exercises a most favourable influence over this exceedingly intractable disease. The great drawback, in this, as in all the other nervous diseases requiring a long continuance of the remedy, is the liability of the patient to the very repulsive discoloration of the surface. It would be an unspeakable benefit to humanity, could means be found of preventing or removing this effect of nitrate of silver, without impairing its therapeutic virtues. The remedy has been used by M. Buchut, with entire success, in a case of idiopathic *infantile paraplegia* (*Ann. de Thérap.*, 1864, p. 225); and the same physician asserts that *general progressive palsy*, whether of the insane, or not thus complicated, sometimes gets well under the use of this remedy, in the dose of from one-third of a grain to about a grain daily. (*Ibid.*, 1866, p. 274.)

Administration. When the effects of nitrate of silver upon the system generally are desired, it should be given preferably in the form of pill; as a larger dose can thus be taken, without irritating the stomach, than in solution. The same form is also preferable when it is given by the mouth for intestinal affections; as there may be some hope that it may thus, in part at least, escape decomposition by the gastric contents. For its alterative influence on the stomach, it may be given in either form; but the solution would probably be most effective if well borne. When taken in pill, it should be mixed up with flour, starch, or powdered gum, with syrup. The crumb of bread, often used, is objectionable on account of the common salt it contains. If given in solution, distilled water should be employed as the menstruum; the taste being covered, if deemed advisable, by a little oil of mint or peppermint. In either case, the preparation should not be long kept before being used.

The dose to begin with, at least in delicate states of the stomach, should not exceed one-quarter or one-third of a grain, three times a day, which may be gradually increased to one, two, or even three grains, should no irritant effect be experienced. Some have pushed the medicine much further, even so far as fifteen or twenty grains, and with impunity; for there are generally in the stomach substances, especially the chloride of sodium, which render it inert by decomposition; and it might unite with the albumen of the mucus, or even superficially with that of the epithelium itself, without serious injury. But these decomposing substances might be wanting, or the mucous coat might be unprotected by its ordinary secretion, and the medicine come into contact with some exposed point with too great intensity; in short, experience has shown that the salt may prove highly irritant, and even poisonous; and there is no occasion to incur any risk, for, as before stated, these large doses are almost wholly decomposed, and pass out of the bowels; a very small portion only being absorbed; so that, when not mischievous, they will probably be useless.

The great point will be to guard against the discoloration of the skin. For this purpose, the mouth should be carefully and frequently observed, and the least appearance of a dark blueness in the gums should be considered as a signal for discontinuing the medicine until this has disappeared. As the nitrate in solution might have the effect of darkening the surface of the mouth by its direct contact, the discoloration thus produced must not be mistaken for that resulting from the absorption of the medicine. Dr. James Johnson states that no case of discoloration is on record, in which the use of the medicine has not been continued beyond three months.* It would, therefore, be a good rule, after having employed it continuously for that length of time, to suspend it for a period, say one or two months; and there is some ground for this suspension in the long retention of the medicine in the tissues, as shown by the experiments of Orfila; so that, though it should be omitted, that already taken and absorbed might still be acting.

The medicine should be taken on an empty stomach, and the caution should be observed that nothing containing common salt, or any other substance having the property of decomposing the nitrate, should be swallowed within a short time, either antecedent or subsequent to its administration.

The following are preparations of silver derived from the nitrate.

1. OXIDE OF SILVER.—ARGENTI OXIDUM. *U. S.*, *Br.*

This is prepared by adding solution of potassa to a solution of nitrate of silver, the oxide being precipitated. It is an olive-brown powder, inodorous, nearly tasteless, and very slightly soluble in water; and consists of one equivalent of silver and one of oxygen. Though used as a medicine, on the continent of Europe, during the last century, it attracted little notice until proposed by Dr. Butler Lane, as a substitute for the nitrate, in the various diseases in which that remedy has been used.

Oxide of silver acts locally as a slight irritant and astringent, but is wholly destitute of the property, which renders the nitrate so valuable, of combining with the tissues. Taken into the stomach, it is either absorbed, or forms soluble compounds which are absorbed; for it produces occasional soreness of the gums and salivation, and has even caused discoloration of the skin.

---

* A case is recorded in which the daily use of half a grain, for eight months consecutively, produced a striking and universal discoloration of the surface. (*Archives Générales*, 5e ser., ix. 358.)

It was substituted for the nitrate as a milder remedy, and capable of producing its constitutional impression, with less danger of affecting the skin; but the want of the property of combining with the superficial part of the tissues, incapacitates it for those local alterative effects on diseased surfaces which give its highest value to the nitrate; and, in proportion as it may be less liable to discolour the skin, it will probably prove less efficacious as a medicine; the liability to produce that effect being incidental to the absorption of the silver, no matter in what form it may be taken up, and consequently in some degree a test of its constitutional influence. It seems to me, therefore, that little is gained by the substitution. Nevertheless, the oxide has been found useful, by Dr. Lane and others, in *gastralgia*, *pyrosis*, *enteralgia*, *dysentery*, *diarrhœa*, *idiopathic night-sweats*, *dysmenorrhœa*, *leucorrhœa*, and *uterine hemorrhage*. In the last-mentioned affection, the favourable report of Dr. Lane is supported by the experience of Dr. Golding Bird; and Dr. Thweatt, of Petersburg, Va., published several cases of menorrhagia, in which the medicine appeared to have proved efficacious. (*Am. Journ. of Med. Sci.*, N. S., xviii. 69.) The oxide would seem to promise most fairly as a substitute for the nitrate in epilepsy, and other spasmodic complaints; but, though it may probably be given with less risk in large doses, experience has not proved that it possesses superior advantages as a remedy. It is said to have been used successfully in tænia.

The dose is a grain, repeated twice or three times a day, which may be gradually increased to two grains. In the larger quantity, it sometimes occasions a little griping and tenesmus, which may be checked by an anodyne enema. (Thweatt, *Ibid.*) The same caution is requisite, in relation to the continuance of the dose, as when the nitrate is employed. It may be given in powder or pill.

The oxide has been used also externally, in powder or ointment, in *ophthalmia*, *excoriated nipples*, *irritable ulcers*, and *venereal sores*; and, smeared on a bougie, has been employed in *gonorrhœa*. The ointment may be prepared with a drachm of the powder and an ounce of lard.

2. CHLORIDE OF SILVER.—ARGENTI CHLORIDUM.

This is made by adding muriatic acid, or a solution of chloride of sodium, to a solution of nitrate of silver. The chloride of silver is precipitated as a white curdy substance, which, when washed and dried, is ready for use. Though white at first, it soon begins to darken on exposure. It is insoluble in water. The circumstance that nitrate of silver is often converted into the chloride in the stomach, has led to the employment of the latter, as likely to produce the same effects on the system, while much less irritant. Many years since, I was induced myself, by this consideration, to try it in epilepsy; but, meeting with no encouraging success, I soon abandoned it. Dr. Perry used it in the Blockley Hospital of Philadelphia, and obtained advantage from it in chronic dysentery. It has been employed also in syphilis, and in other diseases in which the nitrate is recommended; but it has not come into general use. The dose is from one to three grains, or more, three or four times a day. Twelve grains have been given daily for three months, without unpleasant symptoms. A dose of thirty grains has produced vomiting.

3. IODIDE OF SILVER.—ARGENTI IODIDUM.

This may be prepared by mixing solutions of nitrate of silver and iodide of potassium; the iodide of silver being thrown down as an insoluble, greenish-yellow powder. Dr. Charles Patterson, of Dublin, having convinced himself, by experiment, that this preparation does not change colour on exposure to the light, even in contact with organized matter, conceived that it might be advantageously substituted for nitrate of silver, on the ground that it would not be liable to cause discoloration of the skin. In order to determine how far it might possess the therapeutic virtues of the nitrate, he tried the medicine in various diseases; and, though he succeeded in curing a gastric affection of the Irish peasantry, in which the nitrate had been found useful, in ameliorating pertussis, and in relieving a case of dysmenorrhœa, his experience was certainly not, upon the whole, very satisfactory; and a much more extensive series of observations would be necessary, to establish the claim of the iodide of silver to be used as a substitute for the nitrate. Nor is it by any means certain that it might not cause discoloration of the skin; for though, if absorbed unchanged, it might not thus act, the probability is that, before entering the circulation, it would be chemically altered, and that the compound of silver really absorbed would be liable to the same changes in the system, as that which enters the blood-vessels when the nitrate is administered. Nevertheless, the iodide is perhaps worthy of further trial; as, if found to be possessed of the virtues of the nitrate, without its disadvantages, it would be a most valuable addition to the Materia Medica. From one to three grains may be given three times a day, and gradually increased till some disagreeable effect upon the stomach or bowels is produced.

II. COPPER.

CUPRUM.

In the metallic state, copper is quite inert. Instances are on record in which copper coins have remained long in the stomach without any observable effect; and animals which have been made to swallow filings of the metal, to the amount even of an ounce, have in no degree sensibly suffered from them. Yet other cases have occurred, in which local injury to the stomach, or some derangement of the system has followed, under similar circumstances. The result in these instances has, no doubt, depended on chemical changes, by which the metal has been oxidized, and converted into a salt through the agency of the gastric acids; so that it was not the copper itself, but one of its soluble compounds, probably the chloride, that acted.

Copper may generally be detected in minute quantities in the blood of persons in health, and has been repeatedly found in the tissues, when no preparation of the metal was known to have been taken. It has hence been inferred that, like iron, it forms an essential constituent of the blood; and Millon supposed it to enter into the normal constitution of the red corpuscles. But so much copper is taken into the system in various ways with our food, that the exceedingly minute portion which a delicate chemical analysis can detect, has its origin probably in this source, and is only accidentally present in the blood, which would in no degree suffer from the want of it, as it does from the want of iron. Wackenroder has confirmed this view by showing that the blood of domestic animals, living on pure vegetable food, is quite destitute of it; while it may readily be discovered in the blood of the same animals and of man, when fed on a mixed diet. (*Chem. Gaz.*, May 1, 1854, p. 175.) It may be inferred, however, from these facts, that a proportion of copper large enough to be sensible to chemical research, may exist in our economy without impairing health.

Effects on the System. The preparations of copper are locally irritant, and most of them, in a concentrated state, corrosive. Taken internally, in moderate doses, they operate as gentle excitants to the mucous surface of the stomach, increasing the appetite, and producing other effects characteristic of tonic medicines. In over-doses they become irritant; but happily provoke vomiting very promptly; so that, being discharged from the stomach, they have not time allowed them to produce serious and permanent effects, unless taken very largely. In this latter event, as will be seen directly, they are capable of producing fatal inflammation and corrosion of the alimentary mucous membrane. Like nitrate of silver, they decompose the superficial parts of the tissue, forming compounds with albumen, which are of a greenish-blue colour, and, according to Mialhe, soluble in an excess of the salt, when its acid is of vegetable origin, but not when it is mineral.

But the preparations of copper also act on the system generally. This they are enabled to do by the facility with which they enter the circulation. They appear, indeed, to be among the metallic substances most easily absorbed. After one of the salts of copper has been taken for a short time, the metal may be sought for in vain in the alimentary canal, but will be found in the blood, the substance of the liver, and other tissues. When absorbed, moreover, it holds its place in the organism with great tenacity. Orfila states that it may be detected in the liver, intestinal coats, and bones, eight months after having been taken into the stomach. (*Lond. Med. Times and Gaz.*, March, 1852, p. 279.)

No observable effects upon the system, in health, are produced by small medicinal doses of the salts of copper; but the results of their use in disease prove that, even in these quantities, they are not without efficiency. Their action appears to be that of a tonic, especially on the nervous centres, which they strengthen against irritating influences, as explained in the general observations on this subdivision of mineral tonics. (See *page* 388.) When taken too largely, or too long, they give unmistakable evidence of their effects, which may even be poisonous, independently of their direct action on the alimentary mucous membrane.

The *poisonous operation* of the salts of copper is of two kinds, either *rapid* from a large quantity given at once, or *slow* from too long a continuance of relatively small quantities. In both of these modes of action, moreover, there appears to be a union of a local influence on the alimentary mucous membrane, with a general influence dependent on absorption.

1. *Acute poisoning* from a large quantity is attended with a coppery taste in the mouth, nausea, incessant vomiting, violent pains in the stomach and bowels, purging sometimes profuse, severe headache, cramps in the lower extremities, and, in fatal cases, convulsions, palsy of the limbs, and coma. In the lower animals, Orfila noticed, among the last phenomena before death, rigidity of the muscles, and even tetanus. Occasional salivation is also mentioned; and jaundice is not uncommon, generally appearing during life, but sometimes not until after death. The first series of the symptoms here detailed are evidently the direct result of the irritant action on the stomach and bowels; those which succeed depend on a systemic influence directed more especially to the nervous centres, but sometimes exerted on the salivary glands, and not unfrequently upon the blood, as evinced by the jaundice, which probably arises from the destruction of the red corpuscles, and the alteration of their colouring matter. That the nervous symptoms are not merely sympathetic with the gastric disorder is proved by the facts, *first*, that after death the mucous membrane of the stomach and bowels is, in some

instances, found to all appearance quite healthy, especially after speedy death; *secondly*, that the nervous symptoms sometimes precede the gastric and intestinal, and *thirdly*, that similar phenomena have resulted from the poison injected into the veins, or applied to a wounded surface. The ordinary post-mortem phenomena are signs of severe inflammation in the stomach and bowels, gangrenous patches here and there, corrosion and sometimes even perforation of the intestinal mucous membrane, and green discoloration of the tissue to a greater or less extent. The lungs are said also to have been seen inflamed; but this may have been an accidental coincidence.

2. *The slow poisoning*, according to Dr. Corrigan, of Dublin, who has drawn up his summary from an observation of several cases, is attended with emaciation, a cachectic appearance, muscular weakness, colicky pains, cough without discoverable pectoral disease, "and a peculiar characteristic retraction of the gums, with a purple, not a blue edge;" without the severe colic, constipation, and local palsy, which result from lead. (Braithwaite, xxx. 303, from *Dub. Hosp. Gaz.*, Sept. 1853, p. 232.)* Besides these phenomena, loss of appetite and diarrhœa are mentioned

---

* In July, 1855, Dr. Pietra-Santa, who had been favourably situated for observing the effects of copper on the system, read a memoir before the Academy of Medicine of Paris, in which he stated that, after three years of observation, he had come to the following conclusions;—"1. that a person may live in an atmosphere loaded with the dust of copper, without any appreciable alteration of health; 2. that the introduction of powder of copper into the stomach occasions only some slight disturbances of health; 3. that the colic of copper, as previously described by authors, does not exist; 4. that the phenomena described by authors must be attributed to other contemporaneous causes; and 5. that the purple edging of the gums, mentioned by Dr. Corrigan as characteristic of copper poisoning, is not so constant or general as he supposes." (*Arch. Gén.*, 5e sér., vi. 354; and *Journ. de Pharm. et de Chim.*, Avril, 1858, p. 318.)—*Note to the second edition.*

A case of copper-colic, with the stain on the gums as described by Dr. Corrigan, is reported by Dr. Harley, whose patient was a copper-plate printer, and had on one occasion been peculiarly exposed to the inhalation of one of the salts of copper, while cleaning some old plates, from which a dust arose like verdigris. He had suffered twice before in the same way. The symptoms were a sudden and violent pain in the abdomen as if from a blow, somewhat abating and increasing, augmented by pressure rather than diminished, no diarrhœa, and no constipation. There was a sallow, almost clay-coloured complexion, with anxious expression, livid lips, and sunken eyes. He rapidly recovered under the use of spirit of nitric ether, and dilute sulphuric acid, with a little sulphate of magnesia and laudanum, taken in camphor mixture. (*Med T. and Gaz.*, Aug. 1863, p. 129.) It is difficult to reconcile these opposite observations of Drs. Pietra-Santa and Harley, unless upon the supposition, that the "dust of the copper" of the former was the metal itself in a state of minute division; while the powder, which was the poisonous agent in the case described by the latter, consisted of a salt of the metal. The uncombined metal is innoxious, while its saline compounds may be extremely poisonous. (*Note to the third edition.*)

by other observers. I have seen no account of death from this slow poisoning. The symptoms are probably due partly to a chronic irritation of the alimentary canal, partly to a direct action upon the system.

Poisoning by copper sometimes results from the accidental swallowing of one of its preparations used in medicine or the arts, but more frequently from food or drink prepared or kept in copper vessels, which, even though protected by tinning, are nevertheless apt to lose this protection, and to communicate deleterious properties to substances contained in them, especially when these substances are in any degree acid. There is reason to believe that much injury has thus been produced in the digestive organs, if not in the general system, by the habitual use of carbonic acid water, prepared and long kept in copper fountains.

The treatment of the acute poisoning consists mainly in the free use of the white of egg mixed with water, which forms an insoluble compound with the poison, and at the same time facilitates the cleansing of the stomach. Should this not be at hand, recourse may be had to milk, or even wheat flour mixed with water. Ferrocyanide of potassium has also been recommended as an antidote; but, according to results obtained by Dr. Scharder, of Göttingen, it must be considered of doubtful efficacy. Hydrated protosulphuret of iron, recommended by Mialhe, hydrate of magnesia, and sugar, proved inefficacious in the hands of the same experimenter. (*Deutsche Klinik*, 1855, No. 4.) Should free emesis not take place, the stomach should be thoroughly washed out by the stomach-pump. Afterwards the antidote should be administered with a cathartic, in order that it may reach any portion of the poison that may have entered the bowels. The irritation of the stomach and bowels may then be quieted by opiates; and the case otherwise treated on general principles.

The therapeutic applications of copper will be most conveniently treated of, under the heads of its several preparations.

I. SULPHATE OF COPPER.—CUPRI SULPHAS. *U. S.*, *Br.*—*Blue Vitriol.*

Origin. Sulphate of copper exists in solution in the water running from copper mines, from which it is obtained by evaporation and crystallization. But it is more frequently prepared artificially; and the method usually employed in this country is by the direct action of sulphuric acid on copper or its oxide.

Composition. It consists of one equivalent of oxide of copper, one of sulphuric acid, and five of water of crystallization.

Properties. Sulphate of copper is in fine, large, deep-blue, transparent crystals, inodorous, of a strong, harsh, styptic, metallic, and very disagreeable taste, very soluble in water, and insoluble in alcohol. It is slightly efflorescent on exposure. By heat it melts, and loses its water of crystallization, becoming white and opaque; and by an intense heat is decomposed. On the addition of ammonia to its solution, a precipitate is first thrown down, which is dissolved by a further addition of the ammonia, with the production of a beautiful deep azure-blue colour.

Incompatibles. The fixed alkalies and their carbonates, the alkaline earths, the soluble salts of lead, lime, and baryta, acetate of iron, bichloride of mercury, nitrate of silver, borax, tannic acid, and the astringent vegetable substances containing it, yield precipitates with the solution of sulphate of copper, and are therefore incompatible in prescription.

Effects on the System. The effects of this salt are those already described of the preparations of copper in general, with the addition of astringency, in which it much exceeds the others. In short terms, it may be said, in relation to its action on the alimentary canal, to be tonic, astringent, powerfully emetic, highly irritant, and corrosive, according to the quantity swallowed; in relation to its effects upon the system, to be in medicinal doses tonic to the nervous centres, and in excessive doses poisonous by an overwhelming influence upon those centres. Death, with coma and convulsions, has resulted from two drachms of it swallowed. Besides albumen, magnesia has been recommended as specially useful in poisoning by the sulphate.

Therapeutic Application. Sulphate of copper is thought to have been employed as a medicine by the ancients. In regard to its emetic operation, I shall treat of it under the emetics, and as an external remedy, in which capacity it is much used, under the escharotics. It is here considered solely in reference to its tonic, astringent, and alterative action on the stomach and bowels, and its general influence on the system.

1. It is seldom employed for its tonic action on the stomach; but has been highly recommended in *chronic diarrhœa* and *dysentery* from a supposed astringent effect. In certain cases of this kind, it is certainly an admirable remedy. No doubt its astringency renders it useful in some of these cases; but I ascribe its efficacy chiefly to a stimulant and alterative influence upon the ulcerated surfaces, similar to that which it exerts upon old and indolent ulcers externally. It has the great advantage, in intestinal affections of this kind, over nitrate of silver, that it may pass undecomposed through the stomach into the bowels, and thus come into contact with the ulcers. The particular condition in which I have found it specially useful, and in which, so far as my experience has gone, it is equalled by no other remedy, is a kind of *chronic enteritis*, attended with diarrhœa, distressing pains in a particular part of the abdomen, with or without tenderness on pressure, emaciation, great depression of spirits, a pulse often, though not necessarily frequent, and a *moist tongue.* In such cases, I have been disposed to ascribe the obstinacy which they often exhibit, and sometimes in an extraordinary degree, to the existence, within a comparatively small extent of the bowels, of a chronic, indolent

ulceration, which requires a strongly excitant and alterative impression to enable it to take on a healing tendency. I have seen them, after being treated by a diversity of remedies, opiates, astringents, etc., and lingering month after month, without permanent relief, yield most happily to the persevering use of this remedy, combined with a little opium to render it less offensive to the stomach. A beneficial change is usually experienced in a few days, and afterwards regularly advances to a cure. The only adjuvants which have seemed to me advisable, besides the small proportion of opium, are a diet exclusively of milk and farinaceous substances, and the daily use of the hot salt bath. In somewhat larger doses than are necessary in the affection just mentioned, I have no doubt that the remedy would prove highly useful also in certain obstinate cases of chronic dysentery, with ulceration of the large intestines. In the former affection, one-quarter of a grain of the sulphate, with the same quantity of opium, or even less, may be given four times a day, and gradually increased, if necessary, till the stomach is disturbed; in the latter, one-half a grain may form the commencing dose, to be similarly increased. The necessity of the larger dose in the dysenteric affection is that, the seat of ulceration being lower in the bowels, the medicine will have been to a greater degree diminished by absorption before reaching it. Dr. Pereira states that he has, in an old dysenteric case, increased the dose to six grains three times a day, and continued this for several weeks, with no other obvious effect than slight nausea, and amelioration of the disease. (*Mat. Med.*, 3d ed., p. 802.)

2. For its effects on the nervous system, sulphate of copper has been employed in *epilepsy, hysteria*, and other spasmodic, convulsive, or nervous affections; but for these purposes it is generally less esteemed than the ammoniated copper, to which the reader is referred. It has also been recommended in *intermittents*, and might *à priori* be deemed useful in these complaints, from its corroborative influence upon the nervous centres, rendering them, like quinia, insensible to the irritant impressions which give rise to the paroxysms. Though much less efficient than quinia, it might be used as a substitute for that remedy when circumstances prevent or forbid its use; and I have occasionally employed it as an adjuvant in obstinate cases.*

Besides the diseases mentioned, sulphate of copper has been recommended in *dropsy, worms, chronic catarrh* with excessive secretion of mucus, and *catarrh of the bladder;* but I have had no experience with it in these affections, and should have little faith in its efficacy.

---

* The prescription I have employed is as follows. Take of sulphate of copper one grain, sulphate of quinia eight grains, opium one grain. Form with syrup of gum arabic into a mass, to be divided into four pills. One to be taken four times a day.

Administration. The dose of sulphate of copper, to begin with, is one-quarter of a grain, three or four times a day, which may be gradually increased, if the stomach will bear it well, to two grains. In doses of from three to five grains, it would be apt to vomit. It is most conveniently given in the form of pill, which may be made with crumb of bread, or with a mixture of gum and syrup.

II. AMMONIATED COPPER.—CUPRUM AMMONIATUM. *U.S.*

Origin. This is made by rubbing together carbonate of ammonia and sulphate of copper. A reaction takes place, attended with the escape of carbonic acid, and resulting in the formation of a moist deep-blue mass, which, when dried, constitutes the preparation in question.

Composition. Different opinions have been held as to the precise composition of this salt. The most probable is that which considers it a compound of one equivalent of sulphate of ammonia, and one of cuprate of ammonia, the oxide of copper performing the part of an acid in the latter salt.

Properties. It is in the form of a coarse powder, having a beautiful deep azure-blue colour, the smell of ammonia, and an astringent metallic taste. It is readily soluble in water. On exposure to the air, it is gradually decomposed, giving out ammonia, and assuming a greenish colour. It should, therefore, be kept in well-stopped bottles.

Incompatibles. These are the same as in the case of the sulphate, with the addition of the acids.

Effects on the System. Ammoniated copper has the physiological properties of the preparations of copper in general; being less astringent and irritant than the sulphate, but supposed to act more energetically on the nervous centres. In over-doses, it is capable of producing poisonous effects.

Therapeutic Application. This preparation has been chiefly used, in reference to its effects upon the nervous system, in various spasmodic, convulsive, and neuralgic affections. In *epilepsy,* it has been considerably employed, and is among the remedies which have been most effectual, and are at present most relied on. In these respects, it probably stands next to nitrate of silver, over which it has the great advantage of not discolouring the skin. To sulphate of copper it is preferable, from being somewhat less disposed to irritate the stomach, and perhaps somewhat more effective as an antispasmodic. It should be persevered in for a long time, care being taken to guard against any obvious injurious effects on the system. In *chorea, hysteria, pertussis, spasmodic asthma,* and *neuralgia,* it has been recommended, and may be resorted to upon failure with other less irritant substances. It has been used also in *intermittent fever,* in *dropsy,* and against *worms in the bowels.*

Administration. The dose is half a grain, three or four times a day, to be increased, if necessary to obtain its curative effects, to four or five grains, unless it should prove irritant to the stomach. It is most conveniently given in pills, made like those of the sulphate, and may often be usefully associated with assafetida.

A solution of it in water has been used as an injection in *gonorrhœa* and *leucorrhœa*, a collyrium in *opacity of the cornea*, a wash in *prurigo*, and a stimulant application to *indolent ulcers*. According to the effect desired, the strength of the solution may vary from one to thirty grains to the fluidounce of water.

III. ZINC.

ZINCUM. *U.S.*

Metallic zinc is without influence on the system; and it is only in chemical combination that it becomes active. The effects of its preparations are closely analogous to those of the preparations of copper, though less energetic. In relation to their visible topical effects, they are, according to their degree of solubility and concentration, either mildly excitant and astringent, or actively irritant, or escharotic. Taken internally, they operate directly on the alimentary mucous membrane, and, through absorption, on the system at large. In reference to the former of these seats of their action, they are, in small doses, simply tonic and astringent; in larger, promptly and powerfully emetic; in still larger, highly irritant, and even escharotic, sometimes causing death by inflammation or destruction of the mucous membrane. This higher grade of action is exercised only by the soluble preparations. Upon the system at large, when given in small and repeated doses, they produce no sensible effect in health; and it is only by the relief or cure of certain morbid conditions, that they are inferred to exercise a tonic or corroborant influence on the nervous centres, analogous to that of silver and copper. That they are absorbed has been proved beyond question. After having been swallowed, they have been found in the secretions and the solid tissues. Dr. Michaelis, in his experiments on the lower animals, noticed that, though zinc was found in the urine, after the internal exhibition of the oxide, it was more largely eliminated with the bile. (*Arch. Gén.*, 4e sér., xxx. 481.) Taken in poisonous doses, together with the local injury of the primæ viæ, the preparations of zinc sometimes occasion symptoms evincive also of an action on the nervous centres, as coma, convulsions, and paralysis.

It has been a question, the decision of which is of considerable importance, whether the slow and continued introduction of zinc into the system is capable of materially deteriorating the health; in other words, of inducing a state of chronic poisoning, as the preparations of lead and some other metals are known to do. The general impunity under the long use of zinc as a medicine, and the comparatively little inconvenience experienced by those engaged in the various manufactures or applications of the metal, would seem to determine this question in the negative; but facts have been brought forward, which appear to me to place beyond doubt the occasional action of the preparations of zinc in the way referred to. Thus, a patient who took twenty grains daily, for several months, of the oxide of zinc, for the cure of epilepsy, became pale, emaciated, and almost idiotic, with a furred tongue, constipated bowels, tumid abdomen, cold extremities, œdema of the lower limbs, dry, shrivelled skin, like parchment, and a slow, small, very feeble pulse; symptoms, however, which quickly disappeared upon the omission of the medicine, and the use of cathartics, with a tonic and supporting treatment. (*Brit. and For. Med. Rev.*, July, 1838, p. 221.) Several men employed in barrelling oxide of zinc, and exposed for some days to an atmosphere loaded with the powder, experienced, from the beginning, loss of appetite, clammy taste in their mouths, and colic; and, after ten days, were attacked with vomiting, constipation, and violent colic, not unlike the affection produced by lead, and which, as that usually does, yielded to purging and opiates. (See *Chem. Gaz.*, viii. 362.) In another instance, workmen exposed to the powder arising from beaten zinc, were affected with general depression, sore-throat, angina, ulceration of the tonsils, white pellicles on the gums, salivation, fetid breath, nausea, colic, and diarrhœa. The symptoms subsided, upon the abandonment of the occupation, in less than a week. (*Ibid.*) In these instances, it is obvious that large quantities of the powdered oxide must have been swallowed; and it was probably from this source that the symptoms proceeded. They were mainly such as result from a direct irritation of the alimentary canal; and, though it is probable that some of them arose from the absorption of the metal, they were of little importance. They moreover disappeared rapidly, on the removal of the cause, leaving no permanent effect behind. It is satisfactory that the evil from this cause seems so trivial, when compared with that from exposure to the influence of lead, for which zinc is in a course of rapid substitution as a material for painting.

Abundant confirmation has recently been obtained of the morbid influence of zinc, largely introduced into the system, from observations made both in France and England, upon the effects of exposure to the fumes of the metal by the brass-founders. Workmen thus exposed, and especially those who have inhaled freely the fumes of oxide of zinc, arising from the combustion of this metal when heated in contact with the air, suffer much and often from a certain complication of symptoms, which, from an imperfect resemblance to intermittent fever, has received among them the name of *brass-founders' ague*. This subject has been carefully investigated by Dr. E. H. Greenhow, of London; and an essay containing the results has been published in the *Medico-chirurgical Transactions* (A.D. 1862, vol. xlv., p. 177). As stated by him, there is at first a sense of uneasiness or weariness, and of constriction of the chest, followed near bedtime by shivering and coldness, which ends in a hot stage, often attended with headache and vomiting, and invariably succeeded by profuse sweating. The patient is better the next day, but on fresh exposure is liable to fresh attacks, which, however, are quite irregular in their recurrence, and thus differ essentially from the genuine ague. Indeed, a febrile paroxysm, with its precursory nervous disorder, its cold, hot, and sweating stages, seems to have been developed by the presence in the blood of an absorbed poison, acting especially on the nervous centres. It is said that men engaged in this business are seldom long-lived, and are carried off in the end by the development of a pectoral disease called asthma, which, however, according to Dr. Greenhow, is chronic bronchitis. The symptoms might also be ascribed to the vapours of the copper employed; but, independently of the fact that the copper gives off vapours with much greater difficulty, this metal does not cause the phenomena in the absence of zinc.

In poisoning from large quantities of the soluble salts of zinc, the treatment should consist of the use of magnesia or one of the alkalies as an antidote, of free dilution with demulcent drinks, of opium to quiet irritation of the stomach and bowels, and of measures to combat inflammation corresponding with the exigencies of each particular case.

Of the therapeutic application of zinc it will be sufficient to treat under its several preparations. Of these, I would here observe, that, for internal use, all might well be spared except the *sulphate* and *oxide*, from which every curative effect can probably be obtained which the others are capable of producing.

I. SULPHATE OF ZINC. — ZINCI SULPHAS. *U. S., Br.* — *White Vitriol.*

Origin. This was known so early as the middle of the sixteenth century. It is prepared by acting upon metallic zinc with dilute sulphuric acid. The metal is oxidized at the expense of the water, the liberated hydrogen escapes, and the oxide of zinc formed unites with the acid, to produce the sulphate, which is then obtained by evaporation and crystallization.

Composition. The crystallized salt, which should always be selected for use, consists of one equivalent of sulphuric acid, one of oxide of zinc, and seven of water. On exposure, it partially effloresces, and loses much of its water.

Properties. The crystals are small, slender, transparent, four-sided prisms, and in mass very closely resemble those of Epsom salt, for which they have sometimes been mistaken. They are inodorous, of a styptic, metallic, disagreeable taste, very soluble in water cold or hot, and insoluble in alcohol. By heat they are dissolved in their own water of crystallization, which gradually escapes, leaving the salt in the form of a white opaque powder. By an intense heat they are decomposed.

Incompatibles. Sulphate of zinc is decomposed, with insoluble precipitates, by the alkalies and alkaline earths and their carbonates, by the soluble salts of lead, of lime or calcium, and of baryta or barium, by sulphuretted hydrogen and the soluble sulphurets, and by astringent vegetable infusions through their tannic acid.

Effects on the System. These are such as have been described in the general remarks on zinc, and do not require to be repeated particularly here. It is sufficient to state that this is the most astringent of the salts of zinc, and one of the most energetic in its effects on the system, whether medicinal or poisonous. It has been frequently taken, by mistake for sulphate of magnesia, in doses of an ounce or more, and sometimes, though very rarely, with fatal results. Happily, the powerful emetic properties of the salt usually cause the whole of it to be rejected, before it has had the opportunity to produce a caustic effect upon the coats of the stomach. In a case of the kind which fell under my knowledge, one of the severest symptoms was a feeling of excessive constriction of the mouth, throat, and œsophagus: but the patient, who was a young woman, recovered without any serious consequences. Generally, along with incessant vomiting and retching, there is violent gastric and intestinal pain; and, in the fatal cases, there have been observed, in addition, purging, anxiety, restlessness, great prostration, and ultimately convulsions. The treatment required in such cases has been already stated.

Therapeutic Application. As an emetic, sulphate of zinc will be considered particularly with the class of emetics. First, I shall treat of its internal, and afterwards of its external use.

1. For its direct effects on the alimentary canal, the salt has been used in *dyspepsia*, *diarrhœa*, *dysentery*, and *colica pictonum*. As a gentle tonic, in very small doses, it is sometimes beneficial in *simple indigestion;* but it is seldom used in that affection. To *diarrhœa* it is adapted by its strong astringency; but it is too irritant for the disease in its acute form, unless associated with great intestinal relaxation. It is to *chronic diarrhœa* that it is best adapted, and especially to those cases in which there may be a suspicion of ulcers in the small intestines. In these cases, associated with opium in small doses, it is sometimes very useful, though less effective, I think, than the corresponding salt of copper. In *acute dysentery* it should not be used by the mouth, except, sometimes, in the very advanced stages; but it may at any time be tried in the chronic form of the disease, when the tongue remains moist, and the ordinary measures have been employed in vain. There is a *condition of dysen-*

tery in which it may often be used with very great benefit. I allude to cases in which the rectum is the part mainly affected, whether the case be subacute or chronic. In instances of the latter kind, the patient will often suffer long with the most harassing tenesmus; and though, from the want of constitutional sympathy, his general health may suffer less than when the higher portions of the large intestines are inflamed or ulcerated, yet the local distress and inconvenience are so great that life is rendered burdensome. The remedy should here be used by injection, so as to bring it into direct contact with the ulcerated surface. I have been for many years in the habit of resorting to this measure in the class of cases mentioned; and, though the disease may have been of several months' duration, and, in one instance which I remember, had continued a year, they have speedily begun to improve, and generally marched on steadily to convalescence. I usually direct from four to eight fluidounces of water, holding two grains of the sulphate in solution for each fluidounce, with the addition of thirty or forty drops of laudanum, to be thrown up the bowel twice a day. With the use of the salt in *colica pictonum* I have no experience; and I should not be disposed to rely on it, while medicines known to be efficient are at command.

2. In reference to its tonic effects upon the system generally, and on the nervous centres more especially, the medicine has been given in most of the chronic nervous diseases to which the metallic tonics are thought to be peculiarly applicable. *Epilepsy, hysteria, hooping-cough,* and *asthma* are among these complaints; but the one in which it has the highest reputation, and in which experience has shown it to be most efficacious is *chorea*, or St. Vitus's dance. It is certainly among the remedies which I have found most effectual in that complaint, especially when used in connection with occasional purging. Upon the same principle, it will sometimes succeed in interrupting the paroxysms of *intermittent fever*, though probably less efficacious in this affection than sulphate of copper, and incomparably less so than sulphate of quinia, or the arsenical preparations. It is asserted to have proved useful in obstinate *chronic gleet* and *leucorrhœa;* and Dr. Christison, in his Dispensatory, states that, in the dose of from three to six grains twice or thrice daily, he had frequently been successful with it in such cases. It would appear to operate by something more than a mere astringency. It may possibly exert an alterative influence over the mucous membranes, and thus prove useful also in *chronic bronchitis with profuse expectoration*, in which it has been recommended.

Administration. The dose, to begin with, is one or two grains, twice or three times a day, which may be gradually increased, if requisite, as the stomach is found to tolerate it without inconvenience. Dr. Babington has increased to thirty-six grains three times a day; but this can rarely be necessary; and it is probable that all that the medicine can effect may be obtained from much smaller quantities. It may be given in pill or solution.

External Use. There are few more valuable medicines for external use than sulphate of zinc. Being at once excitant and decidedly astringent, it serves to stimulate enfeebled surfaces, and, by contracting their blood-vessels, to obviate inflammation in them. But there is something, also, in its mode of operation, which we do not exactly understand, by which it changes the condition of parts even specifically diseased, and disposes them to take on a healthy action, to which otherwise they would have no tendency. In other words, it is alterative, as well as tonic and astringent, in its local influence.

It has been used as a *simple styptic* to *bleeding surfaces*, though probably inferior in this respect to some other astringents, such as alum and acetate of lead.

As a collyrium in the very commencement of *inflammation of the conjunctiva*, in slight affections of the kind at any stage, in chronic cases or the declining stages of the acute, and whenever the blood-vessels appear to be merely passively dilated, it is among the safest and most efficient remedies. For this purpose, it may be dissolved in rose-water, or in pure distilled water, in the proportion of one grain to the fluidounce, or even less when the eye is very sensitive. The solution may be applied twice a day, and gradually strengthened, if requisite. In very slight cases, which, however, are sometimes troublesome by interfering with the use of the eyes, a single application often proves sufficient.

In *gonorrhœa*, in any stage, unless when the inflammation is very high, and involves more than the mucous membrane, it is a very efficient remedy, if properly used. At the very commencement of an attack, it will sometimes almost immediately arrest the affection. The strength of the solution should not at first exceed two grains to the fluidounce of water, and it may be even weaker in very sensitive conditions of the urethra. To be successful, the injection must be very frequently repeated, so as not to allow the impression to subside before it is renewed; every three or four hours for example, or six or eight times in the twenty-four hours.

In *leucorrhœa* the same injection will often prove highly useful, employed two, three, or four times in the twenty-four hours; but little good can be expected from it when the discharge is sustained, as it too frequently is, by organic disease.

In *chronic inflammation of the rectum*, with mucous discharges, it is an invaluable remedy; whether this condition be original, or a mere accompaniment or consequence of dysentery. The method of administration has been mentioned in the remarks made on the use of the remedy in that affection.

Chronic purulent discharges from the ears, and the same affection of the nostrils known under the name of *ozæna*, are other complaints in which sulphate of zinc is often extremely useful. In these cases, the strength of the solution, at first only two or three grains to the fluidounce, should be increased, as the parts will bear it, to five or even ten grains. Whenever the immediate seat of the discharge can be seen, as sometimes when an ulcer exists, even a stronger solution than the strongest mentioned, may be directly applied to the diseased surface by means of a camel's-hair pencil, leaving the sound parts untouched.

But perhaps the local affections most amenable to the remedy, are *ulcers* and *pseudomembranous patches in the mouth and fauces.* Whenever the surface of the ulcers, in these positions, is covered with a whitish exudation, whatever may be their duration or size, from the small superficial aphthous ulceration to the obstinate and destructive *cancrum oris*, the solution of sulphate of zinc will, according to my observation, effect a cure. I do not include in this category the *gangræna oris*, which I believe to be a different affection, and which is more effectively treated by more active escharotics, as nitrate of silver or sulphate of copper, nor syphilitic ulcers, in which corrosive chloride of mercury is more effectual. The solution should have the strength of fifteen or twenty grains to the fluidounce of water, and should be applied daily or twice a day, by means of a brush or hair-pencil, exclusively to the diseased surface, and continued until the whitish exudation, before alluded to, gives way to a red surface, after which it should be omitted. As soon as this change takes place, the ulcer speedily heals.

A much weaker solution, say of two or three grains to the fluidounce, may sometimes be used in obstinate cases of the *infantile thrush* or *muguet* of the French, with great benefit.

The same remedy is applicable to *all ulcers*, wherever seated, which, in consequence of a loose, flabby, debilitated state of the old tissue, or of the new granulations, refuse to take on the healing process; and especially when the ulcers are attended with a copious purulent discharge. The strength of the solution must, in these cases, vary so much that no precise rule can be given. It may contain from two to twenty grains to the fluidounce.

Dr. F. L. Keyes, of Jerseyville, W. Canada, strongly recommends a solution containing three grains of the sulphate to a fluidounce of water, as a dressing for burns and scalds, of all kinds, except those produced by gunpowder, and containing grains of the powder in the wound. (*Pharm. Journ. and Trans.*, Dec. 1865, p. 338.)

Certain *cutaneous eruptions* yield to the local use of this solution. I have found it specially beneficial in that brownish superficial discoloration, which sometimes spreads over large portions of the surface, to the great anxiety of the patient, and which is now, under the name of *pityriasis versicolor*, recognized as a parasitic affection. Made in the proportion of from two to five grains to the fluidounce, and thoroughly applied morning and evening, the solution has, I believe, invariably within my recollection, effected cures.

Sometimes a mixture of acetate of lead and sulphate of zinc in solution, has been employed as a collyrium, and as an injection in gonorrhœa, preferably to the sulphate alone. In this case, a double decomposition takes place, with the production of sulphate of lead, which is precipitated, and of acetate of zinc, which remains dissolved. If the liquid, therefore, be employed clear, it is the latter salt which is the real agent; if it be agitated, the insoluble sulphate of lead is applied at the same time. It is possible that this salt may add something to the curative effect by affording a sort of protective covering to the mucous surface. When it is the effect of the acetate of zinc alone that is wanted, recourse should be had preferably to a solution of the pure salt. The proportion of the two salts employed is usually three grains of the acetate of lead to two of sulphate of zinc, in a fluidounce of water.

II. ACETATE OF ZINC.—ZINCI ACETAS. *U.S.*, *Br.*

This is prepared by exposing metallic zinc to the action of a solution of acetate of lead. The zinc takes the place of the lead in the solution, while the latter metal is deposited in the pure state. The liquid being now evaporated, and allowed to stand, yields acetate of zinc in crystals. The salt consists of one equivalent of acetic acid, one of oxide of zinc, and seven of water. It is in soft, white, shining, micaceous crystals, which effloresce in a dry air, are inodorous and of an astringent metallic taste, and are very soluble in water, and soluble also in alcohol.

The effects of this salt are essentially the same as those of the preceding, but milder, and less astringent. Though capable of doing injury in excessive doses, it is much less poisonous than the sulphate. It may be given internally for the same purposes, but is seldom used in that way. It is chiefly employed in the form of solution, as a *collyrium* in *ophthalmia*, or an *injection* in *gonorrhœa*. The dose for internal use would be one or two grains. The solution for topical application may contain from one to three grains to a fluidounce of water.

III. VALERIANATE OF ZINC.—ZINCI VALERIANAS. *U.S.*, *Br.*

This may be made by double decomposition between valerianate of soda and sulphate of zinc, dissolved separately in boiling water, and then mixed. Upon evaporation, the valerianate of zinc is formed, being less soluble than either of the other salts, and is separated in the shape of crystals, which float on the surface, and are removed as they appear. The salt is in white, pearly, scale-like crystals, which have a feeble odour of valerianic acid, and a styptic, metallic taste. It is of difficult solubility, requiring 160 parts of cold water, and 60 of alcohol.

Its effects on the system are essentially the same as those of the sulphate, though less astringent. It was introduced into use under the impression that valerianic acid might impart to it greater antispasmodic efficiency than belongs to the preparations of zinc generally. It has proved useful in various nervous diseases, such as those for which the other preparations of zinc are employed; but experience has not satisfactorily shown that it has any superiority over them. The dose is one or two grains, several times a day. It is usually administered in the pilular form.*

IV. PRECIPITATED CARBONATE OF ZINC.—ZINCI CARBONAS PRÆCIPITATA. *U.S.*—ZINCI CARBONAS. *Br.*—*Carbonate of Zinc.*

The U. S. Pharmacopœia directs this to be made by double decomposition between sulphate of zinc and carbonate of soda, mixed in boiling hot solution. It has been introduced among the officinal preparations as a substitute for *calamine*, or *impure carbonate of zinc*, which, as found in the shops, is often a wholly surreptitious substance, containing no zinc whatever, and therefore not to be relied on. The officinal carbonate of zinc is really a subcarbonate; the oxide of zinc being in considerable excess, in consequence of the escape of carbonic acid during the reaction of the two salts used in its preparation.

Precipitated carbonate of zinc is a soft, light, white powder, insoluble in water, and without smell or taste. It is, however, soluble in most acids; and, when applied locally to a secreting surface, may be considered as undergoing solution in very small proportion in the extravasated liquid, through the instrumentality of an acid contained in it, or some other chemical reagency.

Therapeutic Application. This is exclusively topical and external. Probably in consequence of the slight solution, just referred to, which it may be supposed to undergo in the moisture of the surface to which it is applied, it may acquire a very moderate degree of the excitant and astringent properties which characterize the soluble preparations of zinc, and thus produce a positive impression, such as it could not produce in a perfectly insoluble state. But it probably also acts, when in the form of powder, by absorbing the irritating secretions of the diseased surface, and thus in some degree correcting their influence; and, whether in powder or ointment, it has some effect by the exclusion of atmospheric air. It is used in excoriations, whether from the chafing of opposed surfaces, as in fat persons and particularly children; from acrid secretions, as of the upper lip in coryza, or from superficial injuries; also in chapped hands and sore nipples, and sometimes in scalds and blisters. It is applied in the form of powder dusted on the part, or in that of a *cerate* (CERATUM ZINCI CARBONATIS, *U. S.*), made by incorporating two parts of the powder with ten of simple ointment. This has been substituted for the old *Turner's cerate*, which was prepared from calamine.

---

* In the case of a girl of fourteen, troubled with an almost incessant barking cough, no doubt of an hysterical character, a cure was effected, under the care of Dr. Harley, by the use of valerianate of zinc, assafetida, and camphor, aided by a cold douche, with frictions to the spine, night and morning; but it is impossible to say what share the valerianate had in the cure. (*Med. T. and Gaz.*, Aug. 1863, p. 116.)—*Note to the third edition.*

CALAMINE.—CALAMINA. *U. S.* 1850.

This, when genuine, is an ore of zinc consisting chiefly of the carbonate of that metal. It is in hard masses, which are first heated, then pulverized, and afterwards submitted to the processes of levigation and elutriation, in order to reduce them to the state of fine impalpable powder, in which state it constitutes *prepared calamine.*

Both the crude calamine and the prepared, though formerly recognized in our own and all the British Pharmacopœias, have been entirely discarded, in consequence of uncertainty as to its genuineness; substances having been substituted for it, which often do not contain a particle of zinc.

Prepared Calamine (CALAMINA PRÆPARATA, *U. S.* 1850) is in the form of a powder of various colours, according to the particular specimen of ore from which it may have been obtained, either pinkish, yellowish, or brownish. It is inodorous and tasteless, and quite insoluble in water. Sometimes it is in small pulverulent lumps. The sophisticated article often found in the shops is generally of a pink colour. Calamine has the same properties, and is used for the same purposes, and in the same manner as the precipitated carbonate. There was formerly an officinal cerate called *Calamine Cerate* (CERATUM CALAMINÆ, *U. S.* 1850), or *Turner's cerate*, which was made by mixing prepared calamine with yellow wax and lard melted together. It has been superseded by the *cerate of carbonate of zinc*, mentioned above.

V. OXIDE OF ZINC.—ZINCI OXIDUM. *U. S., Br.*

Origin and Properties. The oxide of zinc is prepared either by burning the metal, and condensing the vapours, or by heating the carbonate of zinc strongly, and thus driving off the carbonic acid. Procured by the former method, it has been called *flowers of zinc.* In composition it is a protoxide, consisting of one equivalent of each of its ingredients. It is a white powder, without smell or taste, unalterable in the air, insoluble in water, but readily dissolved by most of the acids.

Effects on the System. Oxide of zinc is probably inert in its uncombined state; but, as there is very often free acid in the alimentary canal, with which it may react so as to form soluble salts, it is capable of producing the characteristic effects of the preparations of zinc on the system. The experiment of Orfila, who gave to a small dog from three to six drachms, without producing any other observable effect than vomiting, is not to be received as a sufficient proof of the inactivity of the oxide; for there may have been no acid present in the stomach, or too little to generate any considerable proportion of soluble salt. Given largely to men, it is said sometimes to have produced vomiting and purging; and even giddiness and intoxication have been mentioned among its effects. As already stated, in the general remarks on the metal, it is capable of acting injuriously when used freely and for a long time. Having recently been largely employed as a substitute for white lead in painting, in consequence of retaining its white colour when exposed to the action of sulphuretted hydrogen, it is a very happy circumstance that, if not absolutely innoxious, it should have proved so much less injurious than that paint. Its general effects on the system, so far as it acts at all, may be considered as identical with those of the preparations of zinc already described.

Therapeutic Application. This medicine has been used in all the nervous affections to which the preparations of zinc are deemed applicable; namely, *epilepsy*, *catalepsy*, *chorea*, *hysteria*, *hooping-cough*, *neuralgia*, and *gastric spasm;* but it is in the treatment of epilepsy that it has enjoyed the highest reputation. If some accounts which have been published of its efficacy are to be relied on, it is capable of curing a very considerable proportion of cases; but they who are familiar with this disease, and know how obstinately, when once established, it resists every variety of treatment, are prepared when they read such reports, to make many allowances for failure in diagnosis, for the deceiving effects of preconception, and for the fact, almost universally noticed, that the paroxysms of epilepsy are often suspended, and sometimes kept long at bay, by anything calculated to excite the hopes and occupy the attention of the sufferers. When the disease is purely functional, it may often, no doubt, be cured, if submitted to treatment at an early stage; and there is as little doubt that it has not unfrequently given way under the use of oxide of zinc; but the number of failures, taking all the cases into consideration, will probably greatly exceed the cures effected by this remedy. It has the advantage over the sulphate, that it is less disposed to irritate the stomach and bowels; and it may, therefore, be used preferably when these organs are peculiarly delicate.

Since the publication of the first edition of this work, the oxide of zinc has acquired some reputation in the treatment of the night-sweats of phthisis. My own trials with it have not been so satisfactory as to induce me to join in its recommendation from personal observation.

The dose is from two to eight grains or more, given three times daily. It should not be indefinitely increased; as conditions of the alimentary canal, in which it may be innocent at one time, may be so changed that it shall prove highly irritant at another. I do not think that the dose of twenty grains should be exceeded; and, should irritant effects be experienced, the smaller doses mentioned should be diminished, or withheld for a time. It may be given in pill, or in powder mixed with syrup.

External Use. As in the case of the carbonate, this preparation may possibly be dissolved, in minute quantities, in the liquid secretion proceeding from diseased surfaces, and thus rendered positively efficient in its action on such surfaces. In the form of powder or ointment, the oxide has been much used as an absorbent, desiccant, and alterative, in *cutaneous eruptions* characterized by copious liquid extravasation, as in *eczema* and *impetigo*, in *excoriations* of all kinds, *superficial burns*, *blisters*, *chapped hands*, *lips*, and *nipples*, and *profusely secreting ulcers*. In *chronic ophthalmia*, it has been recommended in the form of a collyrium, made by diffusing a drachm of the powder equably in three or four fluidounces of mucilaginous liquid; and the same method of preparation has been recommended in cutaneous affections, and for *injections* in *gonorrhœa* and *leucorrhœa*.

Ointment of Oxide of Zinc (UNGUEÑTUM ZINCI OXIDI, *U. S.*) is made by mixing one part of the oxide with six parts of lard. It was intended as a substitute for the old *tutty ointment* (*unguentum tutiæ*) prepared in the same manner from *tutty*, which is an impure oxide of zinc, of uncertain strength, formerly much used, but now nearly abandoned.

VI. CHLORIDE OF ZINC.—ZINCI CHLORIDUM. *U. S.*, *Br.*

The mode of preparing, and the properties of this compound, will be considered under the head of *escharotics*, to which it belongs by its most important application. It is sufficient here to state that it is a soft, greenish-white, translucent substance, deliquescent on exposure, and soluble in water, alcohol, and ether. Its consistence has gained for it the name of *butter of zinc*.

It is locally irritant and caustic, and, in its effects upon the system, corresponds with the soluble salts of zinc already mentioned. In overdoses, it is an irritant poison, producing constriction of the throat, nausea, vomiting, gastric and intestinal pains, cramps in the limbs, and great prostration, with paralysis of the extremities, convulsions, and coma. Several cases of death from it are on record. The indications of treatment are thoroughly to wash out the stomach, to administer albumen freely which is coagulated by it, and afterwards to treat the case with opiates, and such antiphlogistic measures as may seem to be required.

Introduced by Papenguth into medicine, it has been occasionally used by other practitioners, particularly on the continent of Europe, in *scrofula*, *epilepsy*, *chorea*, and *neuralgia*. It has no advantage, that I can appreciate, over the sulphate or oxide, while it is more likely to injure the stomach and bowels. The dose is from half to three-quarters of a grain, to begin with.

Its local uses will be more conveniently detailed under the escharotics; and, among them, the disinfectant property.*

IV. BISMUTH.

BISMUTHUM. *U. S., Br.*

The only preparation of bismuth used in medicine was for a long time the subnitrate; but the subcarbonate has been of late introduced as a substitute, and is now recognized in the U. S. Pharmacopœia; and a preparation containing the citrate of the metal with ammonia has recently been introduced, with the advantage that it may be used in the liquid form; the others being insoluble. These three preparations will be treated of under the present heading.

1. SUBNITRATE OF BISMUTH.—BISMUTHI SUBNITRAS. *U. S.*—BISMUTHUM ALBUM. *Br.*—*White Oxide of Bismuth.*—*Magistery of Bismuth.*

Origin. Subnitrate of bismuth is prepared by dissolving the metal in nitric acid, and pouring the resulting solution into water. Two salts are formed; one a supernitrate, with great excess of acid, which remains dissolved, the other a subnitrate, which is thrown down. The latter is the preparation in question.

Properties. It is a heavy, white powder, without smell or taste, very slightly soluble in water, but readily dissolved by nitric acid. It becomes grayish on exposure to the air, and blackens under the influence of sulphuretted hydrogen. It has been ascertained by Prof. R. E. Rogers, of Philadelphia, that subnitrate of bismuth, as found in the shops, often contains arsenic; and, though this is in small proportion, the fact is sufficient to put the physician upon his guard against pre-

---

* Besides the preparations above mentioned, several others have been employed.

Iodide of Zinc has been recommended as peculiarly useful in cases of chorea, connected with a scrofulous taint. From two to five grains may be given three times a day; but, as the salt is deliquescent, it is best kept and administered in the form of syrup.

Lactate of Zinc has been recommended by M. Herpin in epilepsy, as a substitute for the oxide, to which it is preferable on account of its solubility, more ready entrance into the circulation, and greater uniformity of action. The dose is two grains thrice daily, to be increased as the stomach is found to bear it.

Phosphate of Zinc has been used in epilepsy, by Dr. Barnes, of London, under the impression that in this disease, which especially affects the brain, there might be a demand for phosphorus to supply the cerebral waste. He has employed it, with ascribing large doses of the medicine, unless assured of its perfect freedom from that poisonous ingredient.*

Effects on the System. Ordinarily, when given internally, the oxide produces little observable effect; and very large quantities have been exhibited with perfect impunity. These facts might lead to the suspicion that former observers were mistaken in ascribing active irritant properties to the medicine. But the apparent discrepancy is explained by reference to the very feeble solubility of the salt in water, and to its ready solubility in some of the acids. Whether, therefore, it shall prove nearly inert, or powerfully irritant, may depend on the absence or presence of an acid in the primæ viæ, capable of dissolving it. An instance of death is recorded, which resulted from swallowing two drachms of the subnitrate with a little cream of tartar. It produced the ordinary symptoms of inflammation of the mucous membrane of the stomach and bowels, as pain, vomiting, purging, swollen abdomen, hiccough, etc.; and, besides these, cramps and coldness in the limbs, intermittent pulse, laborious breathing, swelling of the hands and face, suppression of urine, salivation, and delirium. Some of these symptoms were clearly the result of the absorption of the medicine. The patient, who was a man, died on the ninth day. Dissection showed marks of inflammation and gangrene throughout the alimentary canal. (*Christison on Poisons.*) It is quite possible that the accompaniment of bitartrate of potassa may have had some influence in the result, by rendering the salt of bismuth more soluble. Bismuth has not been detected in the urine of persons using it. The effects of the medicine on the system are quite equivocal; but it may probably be ranked with the metallic tonics of the present section more safely than elsewhere.

Therapeutic Application. Subnitrate of bismuth was introduced into medicine by Dr. Odier, of Geneva. It has been supposed to have a peculiar influence over painful affections of the stomach, either directly blunting the sensibility of the nervous tissue of the organ, or operating through the nervous centres. It has been more especially recommended in *gastralgia*, *gastric spasm*, *cardialgia*, and *pyrosis*; and has been found also to allay nausea and vomiting. At a comparatively recent

---

the like object, in other affections attended with exhaustion of the brain. He directs four grains, three times a day, to be given with dilute phosphoric acid, which is its proper solvent.

For further particulars in reference to the *iodide* and *lactate of zinc*, see the U. S. Dispensatory, and, in reference to the phosphate, the *London Lancet*, Am. ed., i. 343. (*Note to the second edition.*)

* The presence of arsenic may be detected by treating, by means of Marsh's apparatus, a solution made by boiling the subnitrate with an equal weight of potassa in five times its weight of water, filtering, and saturating with sulphuric acid. (*Note to the second edition.*)

period, it has been very much employed in different forms of *diarrhœa*, with great asserted advantage. It is not impossible that the small portion dissolved may operate as an astringent; but it is not in this way that the extraordinary effects claimed for it can be explained. Perhaps, as suggested by M. Monneret, it may act by deposition upon the inner surface of the membrane, and the protection thus given against the irritant action of the contents of the primæ viæ. Hence, it is recommended by that practitioner in very large quantities, not less than two or three drachms in a day. It has been specially recommended as extraordinarily efficient in the *diarrhœa of phthisis*, that of *enteric or typhoid fever*, and the *chronic diarrhœa of children.* I can say little of the remedy from my own experience. Having almost constantly failed with it in the gastric affections in which it was originally recommended, I have long ceased to employ it. The dose, as formerly given, was too small. From five to twenty grains may probably be administered with safety, under any ordinary circumstances, to the adult. Cream is said to be an excellent excipient. The caution should be strictly observed, not to accompany its use with that of nitric acid, or indeed any other acid. Dr. Rodolfo Rodolfi, of Brescia, in Italy, has met with much success in arresting the night-sweats, and diminishing the exhausting expectoration in phthisis, from the administration, every two hours, of about two grains of the subnitrate, with the same quantity of sulphur, and about seven grains of bicarbonate of soda. In four or five days, the colliquative sweats are arrested or materially diminished; and in fifteen or twenty days, the expectoration is less copious and easier, and the patient altogether improved. (*Journ. de Pharm. et de Chim.*, Juin, 1866, p. 468.) Topically, the subnitrate has been used, with great asserted benefit, as an injection in gonorrhœa and leucorrhœa, and as an application to scrofulous ulcers. For these purposes, it is either sprinkled on the diseased surface, or applied mixed with water, in the proportion of one part of the powder to six or seven of the vehicle. The subnitrate has also been used advantageously, by Dr. W. R. Hamilton, of Illinois, in protecting the skin against pitting from the small-pox eruption. He first lubricated the face and hands well with olive oil, and then sprinkled the powder over the surface; and repeated the application twice daily. (*Am. Journ. of Med. Sci.*, Oct. 1865, p. 563.) The subnitrate, sprinkled in fine powder on the surface of suppurating wounds and putrescent ulcers, not only promotes suppuration, but is asserted by Riemslach to act also powerfully as a disinfectant, completely destroying the offensive odour. (*Journ. de Pharm. et de Chim.*, 3e sér., xliii. 224.)

II. SUBCARBONATE OF BISMUTH.—BISMUTHI SUBCARBONAS. *U. S.*

This is prepared by mixing solutions of nitrate of bismuth and carbonate of soda, and washing and drying the resulting precipitate. By double decomposition between the two salts nitrate of soda and carbonate of bismuth are produced; the former which is soluble being retained in solution, and the latter thrown down. The process would seem to be very simple; but, on the contrary, as given in the U. S. Pharmacopœia, it is very complex, being rendered so by the necessity of providing against the presence in the preparation of a portion of arsenic, which is often contained in the metal as found in commerce.

Subcarbonate of bismuth is in the form of a white or yellowish-white powder, inodorous and tasteless, of the sp. gr. of about 4, and insoluble in water. It should not give evidence of the presence of arsenic when mixed with sulphuric acid and treated by Marsh's test.

It was introduced into the practice of medicine as a substitute for the subnitrate, the virtues of which it possesses without being so liable to disturb the stomach. It is thought by M. Hannon, of Brussels, to have the advantage over the subnitrate of being more readily dissolved by the gastric juice; but this might be a doubtful recommendation when large doses are given, especially in an acid state of the gastric liquids, as a highly irritant salt might thus be substituted for a perfectly bland powder. The probability is that, as in the case of the nitrate, its efficacy in the complaints of the stomach and bowels, in which chiefly it is given, depends on this very insolubility, which, with its weight, causes it to spread over the mucous surface and give to this a protective coating against the irritant liquids of the primæ viæ. The dose is from fifteen to forty grains, given three times a day before meals, and gradually increased if deemed advisable. It should not be administered in connection with acids.

III. CITRATE OF BISMUTH AND AMMONIA.—Syn. *Liquor Bismuthi*

This preparation was made in order to meet the demand for a soluble form of bismuth, by which its effects on the system might be obtained with greater certainty, and from a smaller dose. Originally made by a secret formula, it was analyzed by Mr. Tichborne, who, having ascertained its composition, devised a method of preparing it, which was afterwards improved by Mr. N. G. Bartlett, of Chicago. For the mode of preparing it, the reader is referred to the U. S. Dispensatory (12th ed., p. 1025). It is believed to consist of one eq. of teroxide of bismuth, one of ammonia, one of citric acid, and five eqs. of water. In the solid state, it is in transparent colourless scales, of a somewhat metallic but not disagreeable taste, very soluble in water, and of an acid reaction. As first prepared it was in the liquid form, and denominated *liquor bismuthi*; but this is not necessary, as the compound keeps well, and may be dissolved when wanted for use. The dose of the salt is two grains, that of a solution prepared by Mr. Bartlett, for which a formula is given in the U. S. Dispensatory, a fluidrachm.

3. *Reconstructive Mineral Tonics.*

It will be remembered that these are tonic substances which enter essentially into the constitution of the system. The only medicines which have been satisfactorily proved to belong to this subdivision of the mineral tonics, are the preparations of iron.

IRON.

FERRUM. *U.S.*

IRON WIRE. *Br.*

It has long been known that iron is a normal constituent of the blood; and comparatively recent researches have shown that it exists exclusively in the colouring matter of the red corpuscles, of which it forms an essential constituent, and, as is generally believed, in definite proportion.* Without it, the red corpuscles could not exist, nor life be supported. In what state of combination it is contained in the colouring matter, has not been ascertained. It is certainly held by a powerful affinity; for it is altogether insensible to the tests by which iron can be detected in all other combinations. The probability is, that it is united, in an elementary condition, either directly with the other elements of the colouring matter, or with some peculiar organic principle, having for it an affinity beyond that of any other body in nature, and capable of being overcome, through chemical agency, only by the destruction of that principle. Hence, it may be found either by burning blood, in which case it is left in the ashes, or by the instrumentality of chlorine, which destroys the animal principle referred to. The part which iron acts in the economy is wholly unknown. The theory of Liebig, which supposes it to be a carrier of oxygen from the lungs to all parts of the system, entering the respiratory organs as a protocarbonate, there becoming sesquioxidized with the escape of the carbonic acid, and afterwards carried away with the arterial blood to supply oxygen to all the functions, and be reconverted into the protocarbonate, though very beautiful, has not been authenticated, and at present must be regarded as at best a plausible conjecture. That iron is the real colouring matter of the blood, has long been regarded as highly probable; nor did the discovery of hematosin as a distinct principle serve in any degree to invalidate this opinion; but if it be true, as asserted by M. Sanson, that hematosin can be deprived of iron without losing its colour, the opinion must be abandoned. Nevertheless, M. Le Canu, on repeating the process of M. Sanson, did not succeed in obtaining the same result; so that it may be considered as a yet unsettled point, whether iron is or is not the colouring principle. (Quevenne, *Arch. de Physiol.*, Oct. 1854, p. 147.) That it has the property, when taken internally, of increasing the redness of the blood, is a familiar fact. A reference to the above physiological points seemed to be a necessary introduction to the consideration of iron as a therapeutic agent.

---

* According to M. Le Canu, about 1 part of it exists in 4400 of blood, and 7 parts in 100 of hematosin. For the blood, the proportion is necessarily variable, as that of hematosin itself is variable; for the hematosin, it is fixed, the combination being definite (*Archives de Physiol., de Thérap., et d'Hyg. de Bouchardat*, Oct. 1864, pp. 144 and 147.)

I. Effects on the System. Whether metallic iron has any direct influence on the system is not certainly known; for, though very decided effects follow its introduction into the stomach, it is supposed that the metal is oxidized and combined with an acid before it operates. Nevertheless, it is by no means certain that the finely powdered metal may not find, among the constituents of the gastric juice, the organic principle with which it is combined in hematosin, and, uniting with this, enter into the blood at once in a state suitable for the part it has to play in the formation of the red corpuscles. This idea does not by any means preclude that of its absorption, and existence in the serum in other forms of combination. In fact, it serves to explain the double action of the metal; that of a tonic in the blood, like any other absorbed medicine of the same class; and that of a reconstructive agent, serving to increase the red corpuscles, by affording an essential constituent in a due state of preparation.

The operation of the *chalybeates*, or preparations of iron, must be considered in reference, *first*, to their local effects upon the tissue with which they are primarily brought into contact; and *secondly*, to their effects upon more or less distant parts, or on the system generally.

1. *In regard to their local operation*, when in any degree soluble, or capable of being rendered so by the reagencies to which they are exposed, they act as *excitants* and *astringents*; the degree in which they produce such effects being very different in the different preparations, and in some measure proportionate to their solubility. If used in small doses, they produce on the stomach only that degree of excitation which is called *tonic*, increasing the appetite, and invigorating digestion; while their *astringent* operation is evinced by a tendency to constipation, and the smaller, dryer, and harder stools, which are apt to follow. If carried too far, they cause irritation of the stomach and bowels, with a sense of heat, weight, or uneasiness in the epigastrium, sometimes nausea and vomiting, and not unfrequently griping pains and diarrhœa. Some of the soluble salts, as the sulphate, sesquinitrate, and chloride, are capable

of producing even dangerous if not fatal inflammation, and thus acting as irritant poisons. The local effects of the chalybeates, applied externally, either to the mucous surfaces or the skin, are of the same nature; but, in the latter instance, the cuticle serves as a protection, and the irritant influence is much less felt.

A phenomenon resulting from the use of iron, though not a part of its physiological operation, is the black colour of the stools which almost invariably attends it. This is caused probably in part by the combination of the sesquioxide with the tannic acid often contained in the food, as in tea and coffee for example, and in part by the formation of the sulphuret of iron through reaction with suphuretted hydrogen in the bowels, or one of the soluble sulphurets. A knowledge of this fact is important; as otherwise wrong inferences might be drawn from the colour of the stools, and lead to improper practice. Instances of this I have myself witnessed. Not unfrequently also the preparations blacken the tongue, in consequence probably of the simultaneous use of astringent substances; and care must be taken not to confound this appearance with the blackness of tongue resulting from disease.

2. The *effects upon the system*, or on parts more or less remote from the surface of application, are next to be considered. These depend upon the absorption of the iron, and are usually not exhibited until a considerable time after its introduction into the stomach. That iron is absorbed has been proved by numerous experiments. Tiedemann and Gmelin found it in the serum of the blood of the mesenteric and portal veins of a horse, to which they had six hours previously given a solution of the sulphate. M. Quevenne has shown that, if iron passes with the urine at all in the normal state, it is in extremely small proportion; and that, after the use of the ferruginous preparations for a short time, the quantity, though still very small, is appreciably increased; proving that, while the kidneys are not the avenue by which the metal is mainly eliminated from the system, it must have been absorbed in order to produce the slight increase observed. (*Archives de Physiol.*, Oct. 1854, p. 104.) It is said also to have been found in the milk, perspiration, and bile. In what state it enters the blood is uncertain; but it is highly probable that, in part at least, it does so, as before stated, in union with an organic principle, and that, in this condition, it contributes directly to the construction of the red corpuscles. Another portion may circulate in the serum in other soluble forms, and simply act as a tonic and perhaps astringent upon the tissues.

After iron has been taken in the ordinary medicinal doses for a few days, often in less than a week, its effects on the system may be seen in an increased redness of the complexion, the lips, and the tongue, a fuller and stronger pulse, and a general exaltation of the organic functions. These results proceed from a greater richness of the blood, in which the proportion of the red corpuscles is increased. If the use of the medicine be continued, a plethoric condition may be induced, indicated by fulness or dull pains in the head, sluggishness of mind, a full strong pulse, increased heat, and a heightened colour of the surface. It is said that pustules of acne are apt to appear on the face, breast, and back. This is a morbid condition, predisposing to active congestion, hemorrhage, and probably inflammation. Hence the danger of an excessive and long-continued use of the natural chalybeate waters, against which they who frequent watering places should be placed upon their guard. These effects are scarcely sufficient to rank iron among medicines poisonous to the constitution. They are but an exaltation of the healthy powers and functions, such as may result from an abuse of food and other agents essential to life. The only mode in which any preparation of iron can become poisonous, is, as before mentioned, by irritating and inflaming the stomach and bowels.

II. THERAPEUTIC APPLICATION. Iron has been immemorially employed in medicine. It has two modes of therapeutic action; one, by a gentle excitement of the functions, and a somewhat constricting effect on the tissues, evinced in the surfaces to which it is directly applied, whether external or internal, and in distant organs or the system generally, through which it circulates in the serum of the blood; and the other, as a reconstructive agent, by affording the material and the influence necessary for the production of new blood-corpuscles, to supply the place of those which may have been lost. In the first method, it operates as ordinary tonics possessing some astringent power; in the second, its influence is quite peculiar and characteristic, unless, as some assert, it may be imitated by manganese. Some therapeutists believe that this reconstructive operation is essentially and purely tonic; that is, that the iron taken as a medicine acts simply by a gentle exaltation of all the blood-making functions, enabling them to form the red corpuscles more abundantly, not by furnishing the material, but by increasing their power of assimilating nutriment. Others, again, think that it acts simply by furnishing an essential constituent of the corpuscles, and that in fact it is nothing more than an article of food. It is probable that the truth embraces both these opinions; and that the chalybeates, in augmenting the red corpuscles, really stimulate the functions, while they render the material more accessible, and furnish it in a state more readily acted on, than as it exists in the ordinary diet. In referring to the several diseases in which iron is used, I shall endeavour to keep in view the two methods of operating here described, though they are often conjoined in the same disease.

1. As a *mere tonic*, iron is much and very advantageously used in *debility of the digestive organs*. Connected with laxatives and aromatics, it is among the most useful remedies in *dyspepsia, and its asso-*

ciated and dependent affections. When no effect on the system at large is required, and the indication is simply to stimulate the mucous membrane of the primæ viæ, one of the soluble preparations should be preferably selected. Unless the medicine is given too largely, the tendency is to produce constipation; and hence the propriety of administering laxatives at the same time. Should irritation of stomach or bowels be induced, the inference is that too much has been given, and the dose should be diminished within the irritating point. Not unfrequently, in these cases, the chalybeate is associated with one of the simple bitters, as well as with a laxative and aromatic; and these may be combined, in the form of pill, powder, infusion, or tincture, to suit the particular necessities of the case.

The *astringency* of the preparations of iron renders them, in connection with their tonic property, advantageous also in *chronic diarrhœa* attended with relaxation of the mucous tissue. The saline preparations are preferred for this purpose, especially the sulphate, and the solution of the nitrate, the latter of which was introduced into use chiefly for its supposed efficacy in this complaint. Great care should be taken not to give them in irritating doses; and they may often be usefully associated with an opiate.

Passive hemorrhage from the stomach or bowels is sometimes beneficially treated with the chalybeates. To the active hemorrhages from these parts they are inapplicable, in consequence of their excitant property. Even in the passive kinds, they should not be trusted to exclusively in threatening cases; their astringency being too feeble; and at best they are usually prescribed rather to meet some coexisting indication, than simply as hæmostatics. This remark, however, though correct as a general rule, is not applicable to the officinal *solution of subsulphate of iron*, which is powerfully astringent, with comparatively little of the irritant property.

Through the circulation they are supposed to operate beneficially as tonics and astringents in passive hemorrhages, and various excessive secretions, as in *hæmoptysis, menorrhagia, hæmaturia, bronchorrhœa, leucorrhœa, spermatorrhœa,* etc.; but, though they are often useful in these affections, it is probably more by their influence upon the blood than their direct action on the tissues. They should never be exhibited when the complaint is associated with a plethoric condition of the circulation, and a sound state of the blood.

General debility, independently of any special deficiency of blood, affords an indication for the use of iron as a tonic. But discrimination is necessary. To the cure of acute debility, such as occurs in low fevers, the chalybeates are quite inadequate; operating both too slowly and too gently for the wants of the system. The preparations of Peruvian bark and serpentaria among the tonics, are much more effectual here. But in the chronic weakness resulting from deficient food, enfeebled digestion, the depressing emotions, previous disease, etc., they act beneficially by gently stimulating the organic functions through the circulation; and when with the debility is connected a special relaxation of the tissues, as in scrofula, and various nameless cachectic conditions of the system, their astringency gives them additional efficacy. But the conditions of debility in which they are indicated, in reference to their tonic and astringent properties, are almost always associated with a defective or depraved state of the blood, in which their reconstructive power is wanted; so that it will be most convenient to consider the several affections under that head.

2. As a *reconstructive agent*, iron is used whenever the red corpuscles are relatively deficient; and such is the case in all instances of impoverished blood. This condition of the blood has received the not altogether appropriate name of anæmia. In women it is often called chlorosis. Some authors make a distinction between these affections. I have been able to discover none that is essential. In the female, chlorosis sometimes comes on without any appreciable cause, possibly from some derangement of the assimilative functions essentially connected with the peculiarities of the sex; but it is also frequently produced in them, as well as in males, from obvious causes; and there is no difference that I have been able to appreciate in the results. The symptoms are the same, the mode of treatment is the same; and the obscurity of the cause, in certain instances, is not a sufficient ground for assuming a distinct character in the affection. The varieties under which anæmia appears are almost infinite. Sometimes it is a pure, original, idiopathic affection; but much more frequently it is associated with other diseases, as their effect, their cause, or a coincident effect of the same cause. In whatever shape it may appear; so far as the anæmia itself is concerned, iron is indicated. It may not always succeed; but it should always be tried when it is desirable to correct the anæmia. Not impossibly, this condition of the blood may sometimes be intended as a safeguard against other affections, perhaps of a hemorrhagic, perhaps of an inflammatory character; and to correct it may involve the patient in the risk of mischief greater than the evils of anæmia itself. In such cases, caution should be observed, in the use of the chalybeates, not to carry them too far; but to endeavour as nearly as possible to preserve a due balance, so that the aims of nature may be effected, without incurring danger in the opposite direction

Simple *anæmia* from the loss of blood, excessive secretion, defective supply of food, or inefficient assimilation, is a very common affection, and in general easily recognizable by the paleness of the face, lips, and tongue. For its characteristic symptoms, the reader is referred to works on the practice of medicine. It may be mentioned here, as having a special therapeutic bearing, that, instead of the depressed state of all the functions, which might, *à priori*, have been anticipated, there is, on the contrary, as a general rule, much and very prominent disturbance of certain functions, even more so than in the opposite condition of the blood. A frequent pulse, palpitation of the heart, panting respiration, and varied nervous agitation, are often striking phenomena; and it is of the utmost importance not to mistake these, as they were formerly often mistaken, for evidences of an over-excitement requiring depletory treatment. There are too, very generally, especially in females, bellows murmurs in the heart and large blood-vessels, to be heard by pressing the ear or the stethoscope upon them, which might lead an incautious observer to suspect the existence of organic cardiac disease. Sometimes, when the disease is not yet fully developed, the characteristic paleness of the cheeks may be wanting, and there may even be in the female something of the rose yet remaining. In this condition, those apparent anomalies above referred to, the palpitations, the pantings, the hysterical disorders, and especially the cardiac and vascular murmurs, become diagnostic symptoms, by which the nature of the case may often be determined. In all these cases of anæmia, iron is the great remedy; and, were it of no other use as a medicine, it would, from the possession of its extraordinary power over this complaint, be of inestimable value. Not only is the anæmia with its immediate symptoms corrected; but evils of great magnitude, which are apt to flow from a perseverance of the affection, such as dropsy, sterility, organic heart affection, and ultimate death from the unresisted attacks of other diseases, are prevented. A sufficient dose of the chalybeate, repeated three times a day, and continued for six or eight weeks, will very generally cure the complaint entirely. In the course of a week or two the colour will begin to return to the lips and cheeks, the pulse to acquire more stability, the appetite and digestive function to improve; the amelioration of the symptoms will advance regularly; and, at the end of the time specified, a wan, wasted, and desponding girl, apparently in the last stage of debility, and quite incapacitated for the performance of any active duty, will have been converted into a cheerful, rosy, plump, and vigorous young woman, full of energy and hope, and prepared to enter zealously upon the duties of her station. This change is effected merely by restoring the healthy proportion of red corpuscles to the blood. The remedy should be omitted when the cure is completed, for fear of inducing plethora. The only caution necessary is that an observant eye should be upon the individual for some months; and, upon the least sign of a return of the symptoms, the chalybeates should be again recurred to.

There is a peculiar form of *anæmia*, different in its origin from the preceding, in which iron is scarcely less effectual. I allude to the *condition of system often left behind by miasmatic fevers*, characterized by a sallow paleness of the surface, general languor and weakness, mental depression, feeble digestion, and often more or less dropsical effusion, sometimes only anasarcous, but sometimes also in one or more of the serous cavities at the same time. There may or may not be attendant disease of the viscera. I believe this condition to be a pure anæmia, resulting from the destruction of the red corpuscles of the blood by the miasmatic poison; the yellowness being attributable to a changed condition of the liberated hematosin. The same condition often follows yellow fever, probably from the same cause. It is delightful to see how rapidly this condition, serious if not relieved, will yield to the conjoined use of iron and quinia. Slight cases will often get well in a week or two, the worst generally within two months. When there is considerable dropsy, however, bitartrate of potassa, to the amount of an ounce, taken through the day, should be associated with the other medicines.

In a large number of diseases, iron is given with a view mainly to the correction of the anæmia with which they are associated. The following list embraces most of them. When, in any one of them, there is an additional indication for the use of the medicine, the fact is mentioned.

Scrofulous affections are often attended with a poverty of the blood which serves to sustain the diathesis, and aggravate the complaint. But there is often also a relaxation of the tissues in these affections, which calls for a joint tonic and astringent action in the remedy. Iron answers both indications; and is very often, therefore, given in the different forms of scrofula. It has, however, no specific influence over the disease, and is used only as an adjuvant to the alterative remedies, such as iodine and cod-liver oil. The iodide of iron is generally preferred, on the presumption that the effects of the iodine may be obtained along with those of the chalybeate.

Phthisis may be ranked among the scrofulous diseases, and might be supposed to call for the remedy equally with the other forms. But there is a consideration connected with this affection, which renders caution in the use of the chalybeates necessary. The anæmia in phthisis is a provision of nature for bringing the blood into a due relation with the capacity of the lungs. If, with the progressive destruction of these organs, the blood should remain undiminished, the quantity passing through the lungs would be more than could be duly oxidized, or indeed carried through the remaining pulmonary vessels. Congestion of the lungs, with hemorrhage, and other evils from a want of due aeration of that fluid, would take place. The use of iron, if successful in its object, might counteract this purpose of nature, by inducing a relative plethora. Nevertheless, the anæmia is often carried far beyond the point essential for its useful purpose; and, in such cases, the chalybeates would be serviceable by lending the support of good blood to the exhausted functions, and even by obviating, in co-operation with other measures, in some degree, the disposition to tuberculous deposition. But they should be omitted, as soon as the blood may be deemed to have become as much enriched as the condition of the lungs will permit, without risk of mischief.

Various *nervous affections* offer indications for the use of chalybeates. Disorders of the nervous system are often nothing more than results of the irritation of the nervous centres, sustained by the constant call made upon them by the functions when suffering from the want of blood. Placed as points of communication between all the functions, and the various agencies intended for the supply of these functions with the means of support, they are constantly receiving impressions, and sending forth influence; and, the degree of their excitement being in proportion to the amount of impression received, they are consequently most excited when the wants of the functions are the greatest. Hence, in an anemic condition of the blood, when all the functions are suffering under the deficiency of this essential pabulum, the nervous centres are necessarily over-excited, and exhibit their irritation by various violences throughout the system. By correcting the condition of the blood, the functions are quieted, the nervous centres are relieved, and the existing obvious disease, so far as it depended on their irritation from this cause, ceases. Hence the use of iron in these complaints. But it operates also on the tonic principle of giving strength to the nervous centres, and enabling them, in a certain degree, to resist the irritative impressions made upon them; though, in this mode of action, it is inferior to the preceding section of mineral tonics, including the preparations of silver, copper, and zinc, which have the advantage over the chalybeates of a *special* influence upon these centres, not possessed by the latter remedies, or, at all events, in a less degree. The chalybeates, therefore, while they are much more energetic and more relied upon in the nervous diseases, when dependent on or aggravated by anæmia, than the other metallic remedies mentioned, are inferior to them under other circumstances. The rational practitioner, guided by this principle, will know when to rely mainly on the chalybeates in these complaints, when to use them as adjuvants of the other metallic tonics, and when to abstain from them as useless or possibly injurious; for, of course, they could do only harm in irritation of the nervous centres dependent on or aggravated by plethora.

Hysteria is one of the affections in which chalybeates are often used advantageously on the principles above stated.

Neuralgia is also frequently benefited by them; and, in many instances of this complaint, they are among the most effectual remedies. In the treatment of neuralgia of the face, or *tic douloureux*, they enjoy a very high reputation; but, no matter what may be the seat of the complaint, provided it can be traced to anæmia as the sole or a co-operative cause, they will prove equally beneficial. In *gastralgia*, they sometimes act very favourably. They are often associated with the narcotic extracts, as of belladonna, stramonium, and conium; and there is probably on the whole, no more effectual combination in the treatment of neuralgia.

Chorea, associated with anæmia, will often yield to the chalybeates when other remedies fail; though, as a general rule, they are inferior in this affection to some other metallic tonics.

In *epilepsy*, they may be tried under similar circumstances; but little reliance can be placed upon them for the cure; as this fearful malady has roots much deeper than an impoverished condition of the blood.

In *spasmodic asthma*, *hooping-cough*, and *amaurosis*, they have been recommended, and may be used to meet their special indication when presented.

Carcinomatous diseases are often usefully treated with iron, which, if it does not correct the tendency to the malignant growth, at least serves, in some measure, to support the system under its exhausting influence, and probably contributes at once to render the patient more comfortable, and to lengthen life.

Mr. Henry Behrend, of Liverpool, has employed iron in *primary syphilis*, and, upon comparing the results with those following the use of mercury, gives to the chalybeate treatment a decided preference; as it appears to be equally effectual, leaves the system in a healthier condition, and is not followed by the occurrence of secondary symptoms. He employs the tartrate of iron and potassa. (*London Lancet*, Am. ed., March, 1857, p. 219.) The reader will please to understand that this statement, in regard to the relative efficiency of the chalybeates and mercurials in syphilis, is made solely on the authority of Mr. Behrend.

In the special diseases of various organs, attended with anæmia, iron is a most valuable adjuvant.

In *chronic hepatitis*, or the shattered state of system left behind by it, the chalybeates are very useful. Invalids from tropical climates often find their health greatly promoted, or quite restored by a residence at chalybeate springs, and by the use of the waters, especially when, as in the case of the Cheltenham waters in England, the iron is associated with saline laxatives. I am disposed to think that the chalybeate, in these cases, does good also by a direct tonic action on the liver. A similar combination of iron and saline laxatives, with the various pleasures of a watering place, is among the most effectual means of cure in certain cases of *jaundice*, which, having yielded in a great degree to other measures, continue afterwards to resist for a long time the best directed efforts of the physician.

In *enlarged spleen*, attended with anæmia, and especially when originating under miasmatic influence, the preparations of iron are highly useful; and, in conjunction with quinia and purgatives, offer the best means of curing that often very obstinate affection. Iron is thought to act specially on the spleen as an astringent, and, as before stated, is said to reduce the bulk of that organ in animals which are kept under its use for some time.

In *organic diseases of the heart,* the attendant anæmia serves often to aggravate the affection, by sustaining an excessive action of the organ. The functions, defectively supplied with blood, call on the nervous centres, and they, in obedience to the call, stimulate the heart, in order to supply, by the rapidity with which the blood is sent, the deficiency in its quality. The flaccidity of the heart, too, in anæmia, renders it more expansible by the forces to which it is subjected. Hypertrophy is aggravated by the former influence, and dilatation by the latter. Without being able to cure either of these conditions, the preparations of iron, by improving the state of the blood, may tend to moderate or control the increase of both; and, in the case of dilatation, may possibly, by their tonic and astringent action on the tissue, even favour a contraction of the organ.

Bright's disease of the kidneys is almost characteristically attended with anæmia, which contributes to the accompanying dropsy, and, when the affection consists in fatty degeneration of the organ, fatally promotes the evil by lowering the vital forces which best resist that destructive process. Iron is here indispensable, and acts powerfully, in aid of cream of tartar and digitalis, in the relief, and sometimes in the cure of the complaint.

Diseases of the *genital organs,* with anæmia, are occasionally benefited by the chalybeates. Independently of their influence on the blood, they may act as tonics on the organs, and by some are supposed to exercise over them a special influence, peculiarly over the uterus. They have not unfrequently relieved *sterility* in women; and the story is told that they first came into vogue by curing the son of an ancient monarch of *impotence.* Their supposed powers in spermatorrhœa, leucorrhœa, and the passive forms of menorrhagia have already been noticed. In *amenorrhœa,* they are among the remedies most relied on. Combined with aloes, they probably restore the suppressed, or increase the deficient menses, in a greater number of cases than any other medicine, or association of medicines. Some suppose them to act as a direct emmenagogue; others, merely by improving the blood. It is probable that they have no specific emmenagogue power, and that their main influence is owing to the change they produce in the blood; but, nevertheless, they probably tend, by their tonic power, to which the uterus seems peculiarly susceptible, to put that organ in a healthy condition when relaxed or debilitated, and thus enable it to perform its functions duly. In this way, they may be readily conceived to be emmenagogue in one instance, and to relieve excessive menstruation or uterine hemorrhage in another.

It remains only to consider the chalybeates in their relation to diseases consisting in a *depraved* condition of the blood, as distinct from a mere deficiency of one of its normal ingredients. Such a condition exists in many low febrile diseases, and is supposed by not a few to be the main pathological lesion in those affections. The corpuscles are not essentially deficient in quantity here, but they, as well as the fibrin, are supposed to be diseased, poisoned probably by the absorbed cause of the fever. Now, it is not an improbable supposition that iron, so useful in the construction of the red corpuscles, may also possess some efficacy in their repair. Hence, it has recently been introduced into use as a remedy in some of these affections. Attention was some years since prominently called to this application of iron by Dr. Bell, of Edinburgh, who spoke in the highest terms of the efficacy of the tincture of the chloride in *erysipelas*. His practice has been imitated by many others, not only in this complaint, but in some of analogous character, particularly *scarlatina* and *diphtheria*.

But it is probably in the *passive hemorrhages*, that the chalybeates prove most useful upon the principle of action now under consideration. Though operating in these diseases also by their astringency, they owe the great efficacy which they sometimes evince much more to their influence on the blood. In the class of hemorrhages here referred to, the red corpuscles, though not wanting in amount, are apparently diseased, and unable to supply that stimulus to the capillaries which is essential to the support of their healthy vital contractility, while the plasticity of the fibrin is so much diminished that it coagulates imperfectly. Hence the vessels allow the escape of blood; and the means of spontaneous cure possessed in other kinds of hemorrhage, through the ready coagulability of the fibrin, are deficient or wanting there. The chalybeates have a tendency to correct this condition, by improving the character of the corpuscles, and probably also, indirectly, that of the fibrin; as there is every reason to suppose that this principle proceeds in part from the corpuscles, and must therefore partake of their qualities. Iron may be given in any hemorrhage of this kind; but it has probably proved, upon the whole, most efficacious in *menorrhagia*.

III. CHOICE OF PREPARATIONS OF IRON. For many of the facts upon which the following conclusions rest, I have pleasure in acknowledging my indebtedness to a memoir by M. Quevenne, published in Bouchardat's *Archives* for October, 1854, in which are presented the results of a vast number of experiments, made by the author, upon the mode in which iron enters the system. These experiments were performed chiefly on dogs, in the stomachs of which an artificial opening had been made, allowing of the examination of their contents, and of the changes going on in them from time to time.

Almost all the ferruginous compounds, soluble in the gastric liquors, are capable of contributing to the formation of the red corpuscles, and of producing the general effects of iron upon the system. Two striking exceptions are offered in the ferrocyanide and ferridcyanide of potassium (*yellow and red ferroprussiate of potassa*), both of which are soluble, but neither is capable of exercising the characteristic influence of iron on the system. They are absorbed with great facility into the blood, but they pass out unchanged with the urine; at least the only change produced is the conversion of the red salt into the yellow before elimination.

Solubility in the gastric liquids is essential to the activity of a chalybeate; and the degree of its solubility may be considered as an approximate measure of its absorbability, and therefore of its power. But the solubility or insolubility of the chalybeates in water, is no criterion of their relation to the gastric liquids in this respect. On the contrary, some of the preparations most insoluble in water are most readily dissolved in the stomach, as, for example, powdered iron, and the protocarbonate. Indeed, the soluble salts of iron almost always undergo precipitation in the stomach, before final solution in the gastric liquids. The precipitate is probably formed by reaction with the organic principles either of the food or of the mucus; and, in the absence of acid in the stomach, would remain undissolved. Acids do not ordinarily exist in the stomach while fasting; but, on the introduction of food, and probably of substances excitant to the stomach, though not nutritive, they are secreted with the gastric juice, to the efficiency of which they seem to be essential. The chalybeate, if introduced into the empty stomach, may possibly excite it to the production of these acids; if introduced with the food, must encounter them in the liquid by which this is dissolved. Though precipitated, therefore, it is always subsequently in a greater or less degree dissolved in the liquor of the stomach. Quevenne ascertained that, if the gastric liquid thus holding iron in solution, be treated by an alkali, a portion at least of the chalybeate is thrown down; and this precipitate was always found, on decomposition, to yield nitrogenous products, proving that it contained an organic principle. This was probably albumen. Mitscherlich inferred, from his experiments, that in the stomach albumen unites with the salts of iron to form compounds, of which those containing the protoxide are soluble in water, those containing the peroxide are insoluble; but both are dissolved by the gastric acids. It is probably, then, in this state of combination with albumen, that the chalybeates, taken into the stomach, finally enter the circulation. Of the changes which the absorbed iron undergoes in the blood, in order that it may be fitted to form a part of the red corpuscles, we know nothing; and conjecture is futile.

The above considerations are calculated to aid us in the choice of chalybeates. In reference to their effects on the system, their mere solubility in water is of no advantage. In fact, it is sometimes otherwise;

for until they are precipitated, they may act as irritants to the stomach, and thus interfere with absorption, and with their own further exhibition. Besides, Quevenne has shown that, as a general rule, they yield a less proportion of metallic iron than insoluble preparations to the gastric liquors. Of these latter, however, the sesquioxide of iron, as represented by the preparation officinally denominated subcarbonate, is an exception; as it gives a less proportion of the metal to that liquor than any other chalybeate in use. Upon the whole, then, when the object is to affect the system through the absorption of iron, as soon and with as little inconvenience as possible, it is advisable to select one of the insoluble preparations, as the *powder of iron*, or, if a soluble one is chosen, to employ the mildest and least irritating, as the *tartrate of iron and potassa*. Should a compound insoluble preparation be chosen, one of the proto-compounds should be preferred to those in which the iron is of higher equivalent value; as the *protocarbonate*, for example, to the sesquioxide. If the object be solely to act on the mucous membrane of the primæ viæ, as upon the stomach in dyspepsia, or on the bowels in diarrhœa, then recourse should be had preferably to one of the more active of the soluble salts, as the *sulphate*, or the *chloride*.

The best period for exhibiting the chalybeate is also a point for consideration. When the aim is to introduce the iron into the circulation, the preparation should be given at the commencement of a meal; as it is then better borne by the stomach, and is placed under circumstances most favourable for solution by the gastric acids. Quevenne ascertained that a dog could bear twice as much, given with food, as upon an empty stomach. A dose which would vomit or purge under the latter circumstances, caused no inconvenience under the former. But, when the operation of the chalybeate is to be confined to the mucous membrane, it should be given on an empty stomach; as it will thus operate with greater promptitude and certainty, while, as the quantity of metal that may enter the circulation is now a matter of indifference, the dose can be regulated according to the effects without inconvenience.

Another fact ascertained by Quevenne is, that the quantity of a chalybeate absorbed is increased somewhat with the increase in the quantity given, but by no means proportionably; so that, in estimating the relative value of two preparations for affecting the system, one yielding iron largely to the blood, the other sparingly, we cannot supply the deficiency of the latter, so as to bring the two upon an equality, by increasing its quantity.

The great multiplication of the chalybeate preparations is unfortunate, as it tends to embarrass the student and young practitioner, without affording him any equivalent advantage; for all the good that can be obtained from the whole catalogue, whether in regard to diversity of effect, or facility of administration, can be equally obtained from one-third, or at most one-half of the number. I have seldom found occasion to prescribe, for internal use, any others than the *powder* (*reduced iron*, U. S.), the *protocarbonate* (*pills of carbonate of iron*, U. S.), and the *subcarbonate*, among the insoluble preparations; and the *sulphate*, the *tartrate of iron and potassa*, the *citrates*, the *tincture of the chloride*, and the *solution of the iodide*, among those which are soluble. I believe that all the remedial effects which iron is capable of producing can be obtained from these chalybeates, which afford also opportunity for every desirable diversity in the form of exhibition, whether in powder, pill, mixture, or solution in water or alcohol.

The preparations may be arranged under the heads of 1. those in the metallic state, 2. the oxides, 3. the salts consisting of an oxide and acid, and 4. the haloid salts.

1. *Preparations of Iron in the Metallic State.*

I. REDUCED IRON.—FERRUM REDACTUM. *U. S., Br.*—*Powder of Iron.*—FERRI PULVIS. *U. S.* 1850.—*Quevenne's Iron.*

This is prepared by passing hydrogen over sesquioxide of iron heated to redness. The hydrogen abstracts oxygen from the sesquioxide, and escapes as watery vapour, leaving the iron in a metallic state. This is powdered, and kept in well-stopped bottles.

Properties. It is a dark iron-gray powder, without smell or taste. A little of it, struck with a smooth hammer upon an anvil, forms a scale having the metallic lustre. Thrown into a dilute acid, it produces effervescence, with the escape of hydrogen. It rapidly oxidizes on exposure to the air, from which it should be as much as possible excluded. If quite black, and but feebly effervescing with dilute acids, it may be looked on as not having been fully reduced, and consequently imperfect.

Effects on the System. Powdered iron produces all the characteristic effects of the metal on the system, but has little action on the stomach locally. Nevertheless, in very large doses, it sometimes disturbs the bowels, and has been known to cause vomiting. When there is any acid in the stomach, it is rapidly dissolved, being probably first oxidized at the expense of the water, and then combining with the acid. From the experiments of Quevenne, it appears to yield a larger proportion of iron to the gastric liquor than any other preparation of the metal, given in the same quantity.

Therapeutic Application. This particular form of powdered iron was first introduced to the notice of the profession by MM. Quevenne and Miquelard, of Paris, and has now come into general use. Its want of taste, the smallness of its dose, and the mildness of its action are valuable qualities; but the facility of its solution in the gastric liquids, and of its absorption, constitutes its great recommendation. It may be employed with advantage in all cases, in which the object is to introduce iron into the system through the circulation. Perhaps no chalybeate is superior to it in this respect. It has been specially employed in anæmia, and acts with great efficiency in this affection, in all cases which are amenable to the influence of iron. An objection has been urged against all the forms of metallic iron, that they occasion unpleasant flatulence, by the hydrogen liberated in the stomach. But, in reference to this particular preparation at least, the objection is rather theoretical than practical; the dose being too small to produce any great effect of the kind. Three grains of it could evolve only about one-tenth of a grain of hydrogen. It is not adapted to those cases, in which the indication is to act exclusively or specially on the mucous membrane of the stomach and bowels by direct contact.

Administration. The dose is from three to five grains twice or three times a day, which may be increased if necessary. From fifteen to thirty grains of the powder prove irritant, disturbing the bowels, and more or less incommoding the stomach, though very rarely vomiting. It may be given mixed with syrup, or in pill.

II. IRON FILINGS.—FERRI RAMENTA. *U. S.* 1850.—FERRI LIMATURA. *Ed.*

These were formerly much more used than at present; and were not dismissed from our Pharmacopœia until the late revision. As kept in the shops, they are too often the mere refuse of the workshops, and are consequently impure, not unfrequently containing particles of copper and other metals. Obtained from this source, they should be pounded and sifted; and may then be, in some degree, further purified by drawing them through a sieve with a magnet, which attracts the iron, leaving the isolated particles of other metals, and at the same time the coarser particles of the iron itself. This method, however, answers but imperfectly; and the only method of securing them, fit for medical use, is to prepare them directly by filing, from a piece of pure soft iron. The present French Codex (A.D. 1866) directs them to be prepared from iron by means of a file of steel, and then beaten so as to obtain a coarse powder, with the grains always uniform. They should be kept quite dry, in well-stopped bottles, to prevent oxidation, and should have a bright and clean appearance.

I have no doubt that iron filings, or *steel-dust* as they were often called in old times, are an efficient chalybeate. The flatulence they may occasion is but a trifling inconvenience, while their mildness, and facility of entrance into the system through the action of the gastric acids, are positive recommendations. The great objection to them is their frequent impurity. They have, however, at present, been entirely superseded by the reduced powder of iron, which has all their advantages, in a still higher degree, without their disadvantages.

The dose of iron filings is from five to fifteen grains. They may be taken in powder with syrup, or in the form of pill.

Porphyrized iron is a preparation directed by the French Codex, and is made by rubbing pure iron filings into the state of *impalpable powder*, by means of porphyry. Its colour is black, probably owing to a partial oxidation. The dose is the same as that of the preceding preparation, or somewhat less.

2. *Preparations of Iron in the State of Oxide.*

I. BLACK OXIDE OF IRON.—FERRI OXIDUM NIGRUM.—*Martial Ethiops.*

Under this name, several preparations have been introduced into use, all of analogous composition, and probably identical medical properties, but differing somewhat in the proportion of their ingredients. They consist of the two oxides of iron, the protoxide and sesquioxide, in different proportions, with or without water. The oxides are combined chemically, the sesquioxide acting the part of acid, and the protoxide that of base; and it is in consequence of this combination that they undergo no change on exposure. If they were mixtures of the two oxides, the protoxide would gradually absorb oxygen until converted into the sesquioxide. Three of them merit particular notice; 1. the scales of iron, 2. the hydrated oxide of the late Edinburgh Pharmacopœia, and 3. the magnetic oxide of the late Dublin and present British Pharmacopœias.

1. SCALES OF IRON.—SQUAMÆ FERRI.

This is the true old *Martial Ethiops.* It consists of the scales which fall from heated iron when hammered on the anvil. These are first powdered coarsely, then purified by the magnet, and finally brought to the state of an impalpable powder by levigation and elutriation. They are of variable composition; the sesquioxide seeming to unite with different equivalent quantities of the protoxide, forming different definite compounds, which are then mixed in uncertain proportions.

2. HYDRATED BLACK OXIDE OF IRON.—OXIDUM FERRI NIGRUM HYDRATUM.—FERRI OXIDUM NIGRUM. *Ed.*

This, though directed in the late Edinburgh Pharmacopœia, has been discarded in the British. It is prepared by precipitating, by means of ammonia, mixed solutions of the sulphates of the protoxide and sesquioxide of iron. The two bases are thrown down, combined with water. According to Wöhler, who originally proposed this preparation, it consists of two equivalents of protoxide, one of sesquioxide, and two of water.

3. MAGNETIC OXIDE OF IRON.—FERRI OXIDUM MAGNETICUM. *Br.*

The magnetic oxide is prepared by decomposing, by means of soda, a solution of persulphate and protosulphate of iron, the former having been obtained by boiling a little nitric acid with sulphate of protoxide of iron so as to sesquioxidize the protoxide. A compound is precipitated, consisting of sesquioxide and protoxide of iron: and the formula was so calculated as to give an equivalent of each of these oxides in the resulting compound, which corresponds in composition with the native magnetic black oxide.

Properties. In all these forms, the black oxide is a blackish or grayish-black powder, inodorous and tasteless, with decided magnetic properties, and insoluble in water. The stronger acids dissolve it without effervescence, showing that it contains no metallic iron. It is unchangeable in the air.

Medical Uses. The black oxide has all the effects of the chalybeates upon the system, and is very mild in its operation. It is more readily dissolved in the stomach than the sesquioxide, but not so readily as the reduced iron above described. It may be used whenever it is desirable to bring the system generally under the influence of iron. The dose is from five to twenty grains.

II. SESQUIOXIDE OF IRON.—FERRI SESQUIOXIDUM.

The proper chemical sesquioxide of iron consists of two equivalents of the metal, and three of oxygen. It constitutes the sole or chief ingredient of several officinal preparations, of which the *hydrated sesquioxide*, the *dry sesquioxide*, the *rust of iron*, and the *subcarbonate of iron* of the U. S. Pharmacopœia require special notice. The first three will be considered here; the last, from its comparative importance, will be treated of distinctly, in an article immediately succeeding the present.

1. HYDRATED SESQUIOXIDE OF IRON.—FERRI OXIDUM HYDRATUM. *U. S.*—FERRI PEROXIDUM HYDRATUM. *Br.*

This is prepared by dissolving sulphate of iron in water, adding sulphuric acid, and boiling; then adding nitric acid in small portions successively, boiling after each addition, until a dark colour is no longer produced; and, finally, precipitating with ammonia in excess, and washing the precipitate with water. The object of the first part of the process is to convert the protoxide of the sulphate completely into sesquioxide, which is done at the expense of the oxygen of the nitric acid. The addition of sulphuric acid is necessary to saturate the sesquioxide formed, which requires more acid than the protoxide in the proportion of its excess of oxygen. The precipitated sesquioxide, after having been washed, is introduced into a bottle, and kept in a moist state under water.

This preparation consists of one eq. of the sesquioxide, and two of water of combination, which it retains when carefully dried.

Properties. Hydrated sesquioxide of iron, as officinally prepared, is a moist, reddish-brown mass or pulp, inodorous, of a slightly styptic taste, nearly insoluble in water, but readily dissolved by most acids. Dried carefully, it is still dissolved by acids, though less rapidly. By standing long, even under water, it acquires a new molecular condition, which, though it does not render it absolutely insoluble, very much impairs its solubility. Heated to redness, so as to be deprived of all its water, it is dissolved very slowly by the dilute acids.

Medical Effects and Uses.—As this preparation, in the moist state, or when carefully dried, is dissolved with considerable facility by acids, it would no doubt act efficiently as a chalybeate; but it is not used for this purpose. It was introduced into the Pharmacopœias as an antidote for arsenious acid; and there can be little doubt that it possesses great efficiency in this respect; often saving life, and perhaps always, if properly employed, unless the injury already done is fatal. It acts by converting the poisonous arsenious acid into an insoluble and inert subarseniate of the sesquioxide of iron. It is true that it will not produce this effect on the undissolved arsenious acid; but it is not in this condition that the poison acts; and if, as it dissolves, there is enough of the antidote present to neutralize the dissolved portion, it prevents evil effects, until the whole of the arsenic can be evacuated from the stomach, and subsequently from the bowels. To prove successful, however, it is necessary that the antidote should be employed in great excess; not less than twelve times as much as the arsenious acid taken being required; and some advise thirty times as much, or even more. As the chalybeate produces no injury, except perhaps a slight irritation, infinitely less deleterious than the effects of the poison, it should be given very freely; and attention to precise quantity is unnecessary. It becomes much less efficacious when dried, or long kept even in the moist state; and should, therefore, if possible, be obtained freshly precipitated when wanted for use. Hence the propriety of keeping a portion of the *solution of the sesquisulphate* (tersulphate of the sesquioxide, $Fe_2O_3, 3SO_3$), as prepared in the process, and precipitating the oxide by ammonia at the time it may be wanted.

2. ANHYDROUS SESQUIOXIDE OF IRON.—FERRI PEROXIDUM. *Br.*—*Colcothar.*

This may be prepared by drying the hydrated sesquioxide above noticed, and afterwards exposing it for a short time to an obscure red heat: or by calcining the sulphate of iron. In the former case, the water of the hydrate is simply driven off, leaving the dry sesquioxide; in the latter, the protoxide of the sulphate is sesquioxidized at the expense of the sulphuric acid, which is partly converted into sulphurous acid, and partly escapes in the anhydrous state. It is a reddish-brown powder, inodorous and tasteless, insoluble in water, and dissolved very slowly and with difficulty by the dilute acids.

Medical Uses.—Taken internally, this oxide is almost inert, as regards any effect on the system, in consequence of its very difficult solubility in the acids. The British Pharmacopœia employs it in the preparation of the *plaster of iron* or *strengthening plaster.*

3. **RUST OF IRON.**—RUBIGO FERRI.

This is made by exposing iron, in the shape of wire or filings, to the action of air and water. The metal becomes in time covered with a powder, which is rubbed off by trituration under water, and, being suspended in the liquid, is poured off with it, and subsides. It may be afterwards brought to an impalpable state by levigation and elutriation. It is chemically a sesquioxide of iron, containing, according to Berzelius, 14.7 per cent. of water. Sometimes, at least, it contains also a minute proportion of the carbonate of the protoxide of iron, to which it probably mainly owes any efficiency which it may possess as a chalybeate. The probability is that, in the process of rusting, when the iron becomes protoxidized, a portion of the protoxide combines with the carbonic acid of the air or water, and, though it very soon parts with most of this on becoming further oxidized, retains a small proportion for a long time, perhaps indefinitely.

Rust of iron is in the form of a light yellowish-brown powder, or of small, pulverulent, conical lumps, into which it has been formed when drying. It is inodorous, nearly or quite tasteless, insoluble in water, and slowly dissolved by the dilute acids.

Medical Uses. It was formerly very much employed to obtain the effects of the chalybeates on the constitution; but, as it was very slow in its operation, in consequence of its difficult solubility in the weak acids, and uncertain, either from the variable quantity of acid present in the stomach, or its own variable proportion of carbonate of the protoxide, it has been to a considerable degree abandoned. The following preparation is more elegant, and has almost universally superseded it. The dose is from five to thirty grains.

III. SUBCARBONATE OF IRON. — FERRI SUBCARBONAS. *U. S.* — *Ferri Carbonas Præcipitatus, U. S.* 1830. — *Precipitated Carbonate of Iron.* — *Crocus Martis.*

This was introduced into practice as a substitute for the old rust of iron. Its claim to the title of subcarbonate cannot be sustained on chemical grounds. Only one compound of carbonic acid and iron is known, and this consists of equivalent proportions of the acid and protoxide. There is, therefore, no known subcarbonate. The preparation under consideration consists mainly of hydrated sesquioxide of iron, with which is associated a variable proportion, always, however, small, of carbonate of the protoxide. In the U. S. Pharmacopœia it was denominated subcarbonate, partly because it had previously held the name of *precipitated carbonate*, which, when its true nature came to be known, was considered quite inappropriate, and partly under the impression that its virtues were, in great measure, ascribed to the small proportion of carbonate contained in it, which could not, therefore, it was thought, be appropriately excluded from a share of the title. The term subcarbonate may, in this sense, be considered as simply signifying that it contains carbonic acid, but not in quantity equivalent to the basic matter.

This preparation is made by precipitating a solution of sulphate of iron with carbonate of soda, and afterwards washing and drying the precipitate. By reaction between the two salts, carbonate of protoxide of iron is formed, which, though of a bluish-white colour when deposited, rapidly changes on exposure to the air, and, before the close of the washing and drying, is converted mainly into sesquioxide of a reddish-brown colour. The protoxide of iron has so strong an affinity for oxygen that, whether separate or combined with an acid, it quickly becomes sesquioxidized on exposure; and, if previously combined with carbonic acid, gives so much of it off as was united with the portion converted into sesquioxide. In the present preparation, however, a small proportion of the carbonate precipitated remains unchanged. The manufacturer sometimes calcines it to improve its colour, thus driving off the water, and probably converting the small residue of carbonate into sesquioxide, very much to the detriment of the preparation. It is said that the beautiful bright reddish-brown powder, often found in the shops, has always undergone this treatment, and should, therefore, be rejected. Unless the powder effervesce somewhat when dissolved in muriatic acid, its fitness for medicinal use may be doubted.

Properties. The subcarbonate of iron is a dull reddish-brown, or somewhat chocolate-coloured powder, inodorous, of a slightly styptic and ferruginous taste, insoluble in water, and soluble with difficulty in the acids, except the muriatic, which dissolves it with some effervescence, owing to the escape of carbonic acid.

Effects on the System. It has little local action on the stomach, and may be taken to an almost unlimited amount, with no other effect than to occasion feelings of epigastric weight and oppression, and sometimes probably slight nausea and vomiting. It may, too, when taken excessively, accumulate in the bowels, and produce some mechanical inconvenience. By far the larger portion passes out of the bowels with the stools, which it blackens. Of a considerable number of chalybeate preparations examined by Quevenne, this gave to the gastric liquor the least proportion of iron. As it can impart to the circulation only so much of the metal as it yields to that liquor, it must be inferred to be among the feeblest in its effects on the system. Nevertheless, experience has shown that it is capable of producing all the general effects of the chalybeates; and, though it must be given in larger doses than most other preparations, it is yet well borne by the stomach, so that the disadvantage of its relative feebleness is in some degree counterbalanced. These large doses are rendered necessary by the small proportion it contains of the carbonate, which, probably, is the ingredient through which, mainly, it is capable of affecting the system.

Therapeutic Application. Little good can be expected from the subcarbonate, as a simple tonic, in reference to its direct action on the stomach and bowels; and it is seldom given for such a purpose. But, with regard to its effects on the system, before the discovery of the protective power of sugar over carbonate of iron, and the consequent adoption of that salt, and while yet the extraordinary chalybeate virtues of the powder of iron reduced by hydrogen were unknown, this was among the most popular of the ferruginous preparations, partly from its ascertained efficiency, and partly from its innocence, even in very large doses; and it is still employed to a considerable extent for special purposes. It is unnecessary to repeat an account of the diseases to which the chalybeates in general, and consequently this particular preparation, are applicable. For this the reader is referred to the general remarks upon the subject of iron. It will be sufficient here to call attention to the special purposes just alluded to.

The therapeutic application for which the subcarbonate is most highly esteemed is to the cure of *neuralgia*. About forty years since, Mr. B. Hutchinson, in a pamphlet on the subject, called the notice of the profession to several cases of *tic douloureux*, which had been successfully treated by this remedy. The practice was quickly imitated by others, with results so frequently favourable, that the confidence of the profession in its efficiency became established. I have frequently employed it myself in this painful and often very obstinate affection, and do not think that I have obtained so much advantage from any remedy, as from a joint use of the subcarbonate of iron and the narcotic extracts, especially that of belladonna. Many cases certainly will resist the influence of this remedy, and others may succeed where this has failed; for there are few affections having a greater diversity of origin, or requiring greater diversity of treatment than neuralgia; but it may, I think, rank among the most efficacious. Its usefulness in this disease suggested its employment in other obstinate nervous affections; and it has been given in a considerable number of cases of *traumatic tetanus* with asserted success. It has also been employed advantageously in *chorea*, and in the *second stage of hooping-cough*, when its nervous character has begun to predominate. As a remedy in these nervous affections, particularly neuralgia and tetanus, the doses employed are much larger than those ordinarily administered merely for the improvement of the blood. From half a drachm to three drachms are given three times a day; and, in one case of tetanus, it was carried to half an ounce every two or three hours. Care should be taken, when these large doses are given, that the bowels should be duly evacuated; and I have generally combined the chalybeate with a little ginger, to obviate its disagreeable effects on the stomach.

How the medicine operates in the nervous diseases, whether merely as a chalybeate, by improving the blood, and exercising a tonic influence directly on the nervous centres, or by some additional and peculiar influence, it is difficult to determine. If upon the former principle alone, the same effects ought to be produced by other chalybeates, still more efficient than it in obviating anæmia. I cannot help suspecting that the operation of its mere mass on the interior surface of the stomach and bowels may have something to do with the result, probably through the sympathies connecting the alimentary canal with the brain and spinal marrow. In a case of very severe neuralgia of the bowels, which occurs to my recollection, the curative effect was so speedy that it could scarcely be ascribed to the absorption of the iron. It seemed to me highly probable that the powder, retained by its weight in contact with the surface on which it was spread, acted as a protective to the mucous membrane, and thus prevented the neuralgic paroxysms, which might have depended on an irritant action of the intestinal contents on the excessively sensitive surface.

Another purpose for which this preparation may be employed is to act as an antidote to arsenious acid. Though not equal to the freshly precipitated hydrated sesquioxide, it has considerable efficacy, and should be resorted to when the other cannot be obtained. But if previously exposed to a red heat, it becomes inapplicable to this purpose, in consequence of the same molecular change which renders it insoluble in dilute acids. It may be given *ad libitum.*

The dose for the ordinary purposes of the chalybeates is from five to thirty grains, three times a day. It may be administered in the form of an electuary mixed with syrup or molasses, and may often be usefully associated, to meet special indications, with aromatic, tonic, and laxative powders, as ginger, columbo, and rhubarb.

The *Iron Plaster* (EMPLASTRUM FERRI, *U. S.*) is made from this preparation, by incorporating it with lead plaster and Burgundy pitch, previously melted together. Under the impression that this plaster serves to strengthen debilitated parts, it has commonly been called *strengthening plaster*, and employed in weakness of the loins and joints. But there is no reason whatever to suppose that the chalybeate can penetrate the cuticle so as to reach the part affected; and the notion of the strengthening influence of the iron is probably quite illusory. Neverthebus, the plaster may prove useful in some cases of chronic rheumatism, or other inflammatory affection of these parts, through the revulsion effected by the gentle irritation it sustains upon the surface; and the muscles or joints, being thus relieved of the disease which interferes with their functions, seem to be strengthened.

3. *Preparations of Iron in the Saline State.*

I. PILLS OF CARBONATE OF IRON.—PILULÆ FERRI CARBONATIS. *U. S.*—FERRI CARBONAS SACCHARATA. *Br.*—PILULA FERRI CARBONATIS. *Br.*—*Vallet's Ferruginous Pills.*

The protoxide of iron has so powerful an affinity for oxygen, that it cannot remain an instant in contact with air, or water containing air, without undergoing a partial change into sesquioxide; and a brief exposure is sufficient to render that change almost complete. The same property is evinced when it is combined with acids, and especially with carbonic acid. Hence, as soon as the carbonate of the protoxide is precipitated from a solution of the mixed salts out of which it is formed, it begins to absorb oxygen, and give out carbonic acid, until, as explained in the foregoing article, it is almost wholly converted into sesquioxide.

Now it is believed that the protoxide and its compounds find a readier entrance into the system than the sesquioxide and its compounds; and the fact is beyond all doubt in relation to the carbonate, which experience has shown to be much more efficient, in bringing the system under the influence of iron, than the sesquioxide resulting from its exposure.

The difficulty, however, was to preserve the carbonate unchanged till it could be administered. It had been discovered that sugar had the singular property of impeding, if not preventing the oxidation of iron; and the idea suggested itself to a German physician of the name of Becker, that this property might be taken advantage of for medicinal purposes. The idea was carried into effect by Klauer, a German chemist, who prepared a carbonate of iron so protected by sugar that it resisted the tendency to sesquioxidation. M. Vallet, of Paris, improved the process; and hence, the preparation adopted by the U. S. Pharmacopœia, and most used in this country, goes commonly by the name of *Vallet's ferruginous pills.*

Preparation. According to the U. S. process, sulphate of iron and carbonate of soda are dissolved in separate portions of *sweetened* water; the solutions are mixed in a bottle which they just fill, and which is well stopped to exclude the air; the precipitate of carbonate of iron thus formed is separated, and washed with *sweetened* water; and, lastly, having been allowed to drain, the mass is instantly mixed with honey and sugar, and evaporated to a consistence *fit for the formation of pills.*

The British Pharmacopœia simply mixes the two salts dissolved in water, and, after washing the precipitated carbonate, mixes it with sugar, and dries at a heat not exceeding 212°. The preparation thus obtained is denominated *Ferri Carbonas Saccharata* (*Saccharated Carbonate of Iron*), and is converted into pill by rubbing with confection of red roses.

As the slightest exposure of the carbonate is attended with change, it is desirable that the protecting influence of the saccharine matter should be present in every step of the process; and that, until it is completed, there shall be no avoidable exposure to the air. These conditions are fulfilled in the U. S. process, adopted from Vallet; and the resulting preparation, therefore, is the unchanged carbonate of the protoxide simply incorporated with sugar.

In the British formula, oxidation is going on from the commencement of the process to the moment when the sugar is finally added; and consequently a considerable proportion of the carbonate is changed into sesquioxide. It is obvious, therefore, that, of the two preparations, that of the U. S. Pharmacopœia is to be preferred.

Properties. The U. S. preparation is a soft mass, of such a consistence as to be readily made into pills. It is black, of a sweet and strongly ferruginous taste, and readily and wholly soluble in muriatic acid, with brisk effervescence. The British preparation is a grayish-green powder, having a similar taste, and in like manner soluble in muriatic acid. The former consists exclusively of carbonate of protoxide of iron with somewhat more than half its weight of sugar; the latter has the same ingredients with an uncertain proportion of sesquioxide of iron.

Medical Uses. This preparation is little used for obtaining the direct effects of the chalybeates upon the primæ viæ, for which it is not adapted. But, in reference to its effects on the system, it is one of the best chalybeates, probably upon the whole inferior to none; being at the same time perfectly mild in its action on the stomach, which it very seldom offends, and readily and wholly soluble in the gastric liquids, and therefore absorbable into the circulation. Abundant experience has proved both its gentleness and efficiency. I have been in the constant habit of using it, and have always calculated, with the utmost certainty, upon the desired effects from it, so far as these might depend on the impregnation of the system. In the Pennsylvania Hospital there is a constant succession of patients, especially in the autumn, in the most pitiable state of anemic debility, often complicated with œdema of the limbs, to whom a dose of this medicine three times a day, with a little quinia and nutritious diet, in the course of from two to four weeks, and sometimes even a shorter period, restores healthy colour and strength. Indeed, whatever can be accomplished by any one of the chalybeates towards improving the blood may be expected from this. There are others preferable for some special purpose, or on particular occasions from their solubility, or in reference to a direct action on the mucous membrane of the primæ viæ, but none, I believe, as a reconstructive agent, to build up a debilitated system by the restoration of red corpuscles to the blood.

The dose of the pilular mass is from three to ten grains three times a day. Five grains may be given in a pill without inconvenience. More than fifteen grains would be liable to produce irritation of the stomach or bowels. Of course, if continued so as to produce plethora, the medicine may occasion headache and other unpleasant symptoms.

There are two officinal preparations which may be most conveniently noticed here, because the aim in them, so far as their chalybeate ingredient is concerned, is to produce the carbonate of iron. though, from the deficiency of sugar, this undergoes a somewhat rapid change into sesquioxide. The preparations referred to are the *Mistura Ferri Composita*, and the *Pilulæ Ferri Compositæ* of the U. S. Pharmacopœia.

1. COMPOUND MIXTURE OF IRON.—MISTURA FERRI COMPOSITA. *U. S.*, *Br.*

This is prepared from sulphate of iron, carbonate of potassa, and myrrh, with spirit of lavender and a little sugar to flavour it, and rose-water as the vehicle. When freshly prepared, it is greenish, and may be kept so if perfectly excluded from the air; but the least exposure changes its colour, in consequence of the sesquioxidation of the protoxide of iron of the carbonate, which results from the mutual reaction of the two saline ingredients. A large addition of sugar would have a tendency to prevent this change. It is an imitation of the *antihectic myrrh mixture of Dr. Griffith*, which at one time had considerable celebrity. It combines the effects of myrrh with those of the chalybeates, and may therefore be given in anemic states of the system, with amenorrhœa, and chronic catarrh; but should never be administered in inflammatory conditions of the gastric mucous membrane. I have seldom found much benefit from it in phthisis, in which it was formerly employed. The dose is one or two fluidounces two or three times a day.

2. COMPOUND PILLS OF IRON.—PILULÆ FERRI COMPOSITÆ. *U. S.*

These pills are made with sulphate of iron, carbonate of soda, myrrh, and syrup sufficient to form a pilular mass. Carbonate of iron results from the double decomposition of the two salts, but by time and exposure is converted into the sesquioxide. The pills are no doubt useful as a tonic and emmenagogue; but, since the introduction into use of the pills of carbonate of iron, have no sufficient end to answer. Their intended effects would be better obtained by combining the latter preparation with myrrh, in such proportions as might seem best adapted to the particular occasion. The dose is from two to six pills, equivalent to about six and eighteen grains of the mass.

3. NATURAL CHALYBEATE WATERS.

These belong to the present head, as they generally owe their virtues to the carbonate of iron they hold in solution. Carbonate of iron is insoluble in water, but is dissolved by water impregnated with carbonic acid gas. Water which has been exposed to the air always contains a small proportion of carbonic acid, sufficient to enable it to dissolve a portion of the carbonate. Hence ordinary spring or river water, remaining long in contact with ores of carbonate of iron, would be more or less impregnated; but when waters highly carbonated are similarly exposed, they become of course much more strongly chalybeate. All chalybeate waters, when exposed freely to the atmosphere, gradually part with their iron; the protoxide of the carbonate being converted into the sesquioxide, which, being insoluble, and incapable of uniting with carbonic acid, is deposited. Hence the yellowish-brown deposit in springs of this kind, and the track of a similar colour, which marks the course of a chalybeate streamlet. The pure chalybeate waters act upon the system in the same manner as the officinal carbonate, and probably, from the dissolved state of the salt, with still greater facility. They are admirably adapted to produce all those beneficial changes in the system for which the chalybeates are generally given; especially when drank at their native sources in mineral springs, where they are often aided by the invigorating influence of pure air, exercise, and agreeable association. They may, however, be abused; and it is necessary to be cautious in their use in health, and not to continue them too long in debility, lest plethora should be induced, with its risk of hemorrhage and inflammation, or fever. The natural chalybeate waters appear to be occasionally diuretic, and are thought to have proved useful in chronic nephritic diseases.

Artificial chalybeate water may be made by dissolving a mixture of sulphate of iron and bicarbonate of soda in carbonic acid water. Ten grains of each of these salts, powdered and intimately mixed, and then dissolved in a tumbler of the water, will afford a lively drink, containing four grains of carbonate of iron, with a little sulphate of soda, and an excess of the bicarbonate. The whole quantity may be taken at once, morning and evening.

II. SULPHATE OF IRON.—FERRI SULPHAS. *U.S.*, *Br.*—*Green Vitriol.*

Preparation. For medical purposes, this salt should be prepared by heating together dilute sulphuric acid and iron wire. The iron is oxidized at the expense of the water, hydrogen escaping with effervescence; while the acid unites with the oxide to form the sulphate of the protoxide, which remains in solution. In order that there may be no admixture of the sesquioxide, which it is desirable to avoid, the iron should be in excess, and, after the resulting solution has been poured off, a very little sulphuric acid should be added; care being taken, in the subsequent filtration, evaporation, and crystallization, to exclude atmospheric air as much as possible. This is the process of Bonsdorff, which has been adopted in the U. S. Pharmacopœia, and affords a pure sulphate of the protoxide.

Composition. Crystallized sulphate of iron consists of one equivalent of sulphuric acid, one of protoxide of iron, and seven of water.

Properties. Obtained in the manner above described, the crystals are of a fine bluish-green colour. If quite green, they contain a considerable proportion of sesquioxide. They are inodorous, of a strongly astringent, inky or ferruginous taste, very soluble in water, and insoluble in alcohol. A moderate heat drives off their water of crystallization, and reduces them to the state of a whitish powder. By an intense heat they are decomposed, sulphurous and sulphuric acids being given off, and the red sesquioxide remaining. Prepared by the method of Bonsdorff, they undergo little change upon exposure, on account of a minute quantity of uncombined sulphuric acid contained in them; but, as ordinarily found in the shops, they effloresce in the air, and at the same time absorb oxygen, with the production of a red subsulphate of the sesquioxide. In consequence of this change, they first become quite green, and afterwards more or less covered with a whitish or reddish-brown powder; the latter colour predominating after long exposure. Their solution, which reddens litmus, is at first bluish-green, but afterwards becomes successively green, greenish-brown, and reddish, through the absorption of oxygen, and the gradual conversion of the protoxide into sesquioxide; the latter being partly deposited in the state of an insoluble subsulphate of the sesquioxide, and partly remaining in solution as the neutral sulphate of the same oxide. When the liquid has assumed a clear red colour, this change may be considered as complete, and no protoxide is left. The solution, however, may be kept in the original state, by means of iron wire, which appropriates the oxygen as fast as absorbed; and sugar has the same effect by its peculiar influence in preventing the oxidation of iron. The sulphate of iron of the shops almost invariably contains more or less of the sesquioxide.

Incompatibles. This salt is decomposed by the alkalies, the alkaline carbonates, soaps, lime-water, the soluble salts of lime, lead, and baryta, the borate and phosphate of soda, nitrate of silver, the soluble sulphurets, and ferrocyanide of potassium. When a perfectly pure sulphate of the protoxide, it is not affected by tannic acid, or the vegetable astringents; but, as kept in the shops, it always yields a black or bluish-black precipitate with these reagents, in consequence of the sesquioxide of iron contained in it. But, though it gives precipitates with the above substances, it does not follow that they are all medicinally incompatible. On the contrary, it is often given in connection with an alkaline carbonate, with a view to the production of the carbonate of the protoxide, which is a milder salt, and may be more advantageously employed when the object is to affect the general system. The officinal *compound mixture of iron,* and *compound pills of iron,* are prepared on this principle. (See *page* 451.)

Effects on the System. Sulphate of iron is locally excitant and actively astringent. On the stomach, in moderate doses, it operates often very kindly as a tonic, and in the bowels is apt to produce constipation by its astringency. In larger quantities it becomes irritant, causing heat and uneasiness in the stomach, and, in excessive doses, nausea, vomiting, and diarrhœa, with griping pains. In great excess, it may even prove poisonous by inflaming the stomach and bowels. Orfila found two drachms to kill a dog; and Dr. Christison states that he has met with a case, in which half an ounce seemed to have proved fatal in a child. (*Christison's Dispensatory.*) It is no doubt capable of bringing the system under the influence of iron; but it is probably never absorbed as a sulphate; undergoing decomposition in the stomach, and forming new compounds before it is dissolved by the gastric juice. In the mean time, it exercises its excitant influence upon the mucous membrane of the stomach; and, if given freely, with a view to the impregnation of the system, it endangers unpleasant symptoms of gastric and intestinal irritation.

Therapeutic Application. From the above considerations, it may be inferred that sulphate of iron is useful as a tonic in dyspepsia, and as a joint tonic and astringent in relaxed states of the bowels attended with diarrhœa. In the defective appetite and feeble digestion of convalescence, especially when accompanied with an atonic diarrhœa, it is particularly indicated; and it may be used with hopes of benefit in passive hemorrhages from the stomach or bowels. It has often, moreover, been employed, with a view to its operation through the circulation, in anemic affections, amenorrhœa, passive hemorrhages generally, colliquative sweats, diabetes, excessive secretion from the mucous membrane of the urinary passages, leucorrhœa, and chronic catarrh with exhausting expectoration; but, for reasons stated in the preceding paragraph, it is not so well adapted for the chalybeate impregnation of the system as some of the milder preparations, and has been nearly superseded by them. It has also been used in intermittent fevers, and for the destruction of the tape-worm; but is of little real service in either of these affections.

Administration. It may be given in pill or solution. If in the former method, it should first be deprived of its water of crystallization; as, if made from the crystals, the pills would be apt to crumble from the efflorescence of the salt. In this state, it is officinally directed under the name of *Dried Sulphate of Iron* (FERRI SULPHAS EXSICCATA, *U.S.*, *Br.*). In solution, the salt may be given dissolved in sweetened water, in order to protect it from oxidation, or in carbonic acid water, which aids its tonic effect in dyspepsia. The dose of the crystallized sulphate is from one to five grains, of the dried from half a grain to three grains.*

The British Pharmacopœia has a preparation denominated *Granulated Sulphate of Iron* (FERRI SULPHAS GRANULATA, *Br.*), which differs from the crystallized simply in having been made to assume the form of a coarse powder by agitation during crystallization. It is said to have the advantage of oxidizing less readily by exposure. The dose is the same.

External Use. Sulphate of iron has been considerably used as a topical remedy. In the aggregate solid state, in powder, or in strong solution, it has been used to check the oozing of blood from hemorrhagic or wounded surfaces; in weaker solution, as a collyrium in ophthalmia, and an injection in gleet, leucorrhœa, and prolapsus ani; and, in the same form, as a wash in indolent or flabby ulcers, and cutaneous eruptions, especially in the lichenous or herpetic ring-worm of the face. The strength of the solution may vary, according to the purposes for which it is used, from one to twenty grains to the fluidounce of water; the feeblest proportion being used in ophthalmia, the strongest to arrest hemorrhage, or with a view to a powerful alterative influence on limited surfaces, as those of diseased ulcers, and patches of chronic cutaneous eruptions. Velpeau has found it the most efficacious local remedy that he has used in *erysipelas*, stating that it never fails to cut short the inflammation in one or two days. He uses a lotion consisting of about half an ounce of the salt dissolved in a pint of water, which is aplied by compresses, frequently wetted so as to keep the skin constantly moist. (*Lond. Med. Times and Gaz.*, March, 1855, p. 239.)

Sulphate of iron is one of the salts which has been applied to the interior of the larynx and the bronchial tubes, in the form of spray, by means of the atomizer. (See *page* 76.) It may be used in ulceration and chronic inflammation; and the solution may be employed of a strength varying from one to ten grains to the fluidounce of water.

1. SOLUTION OF SUBSULPHATE OF IRON.—LIQUOR FERRI SUBSULPHATIS. *U. S.*—*Astringent Solution of Sulphate of Iron.*—*Monsel's Solution.*

This preparation of iron was brought into notice, a few years since, as a powerful styptic, by M. Monsel, surgeon to the military hospital at Bordeaux; and was introduced into the U. S. Pharmacopœia at the late revision. It is prepared by boiling powdered sulphate of iron in a mixture of dilute sulphuric and nitric acids until red vapours cease to escape, and the liquid becomes of a deep ruby colour. The object of the nitric acid is to sesquioxidize the protoxide of the sulphate, and of the sulphuric acid to meet the demand of the sesquioxide produced for a greater amount of acid to saturate it; but, as the quantity of sulphuric acid is not sufficient to neutralize the whole of the sesquioxide produced, the result is necessarily a subsalt of the sesquioxide; and this, therefore, is correctly designated in the Pharmacopœia as subsulphate.

---

* In a communication to the *London Medical Times and Gazette* (xiii. 64), it is stated by the writer that he had found the use of rhubarb, conjointly with the sulphate of iron, to prevent the blackening of the stools occasioned by the latter medicine, as by other chalybeates, when used alone, or in other form of combination. (*Note to the second edition.*)

The solution is inodorous, of a deep reddish-brown colour, and of an extremely styptic taste, without causticity. Its sp. gr. is 1.552. When evaporated to dryness, it yields a reddish salt, which is soluble in water and alcohol without decomposition. It is thought to contain 2 eqs. of sesquioxide of iron and 5 eqs of sulphuric acid ($2\ Fe_2O_3,\ 5\ SO_3$), and is probably a double salt, consisting of one eq. of tersulphate of sesquioxide of iron ($Fe_2O_3,\ 3\ SO_3$) and one of bisulphate of the sesquioxide ($Fe_2O_3,\ 2\ SO_3$).

The property to which it owes its therapeutic value is that of producing a speedy and firm coagulation of the blood, whereby it is enabled to arrest hemorrhage more quickly and effectually than most other styptics; while it is less irritant than the other medicinal sulphates. It is used to suppress bleeding from wounds, also spontaneous hemorrhage from the mouth, nostrils, and fauces, and from the uterus, whether active or passive. It is said to have proved peculiarly efficacious in chancre.

The solution has also been used internally, and, in consequence of its exceeding astringency, with little relative irritating power, would seem to be peculiarly applicable to hemorrhage from the stomach and rectum; being swallowed in the former case, and administered by enema in the latter. It may be given in the dose of from three to ten drops.

2. SOLUTION OF TERSULPHATE OF IRON. — LIQUOR FERRI TERSULPHATIS. *U. S.* — *Solution of Persulphate of Iron. Br. Appendix.*

This solution was introduced into the Pharmacopœias chiefly as a step in the preparation of various important chalybeates, and is therefore less immediately interesting to the practitioner of medicine than to the pharmaceutist. Containing the sesquioxide of iron, and yielding it in a state peculiarly suitable for combination with acids, it is used very conveniently in the formation of other salts having the sesquioxide for their base. It is sufficient to say of it, that it is prepared by boiling sulphate of iron with a mixture of dilute sulphuric and nitric acids, in such proportions that the protoxide of iron shall be completely sesquioxidized, and the resulting sesquioxide neutralized by the sulphuric acid; that the solution thus obtained is a clear reddish-brown liquid, inodorous, sourish and extremely astringent to the taste, and, according to the U. S. Pharmacopœia, is of the sp. gr. 1.320; and that it is readily precipitated by solution of ammonia, yielding a hydrated sesquioxide of iron, which is highly interesting to the physician, as the only reliable antidote to arsenic. As the antidotal efficacy of this hydrated sesquioxide of iron is proportionate to its freshness, it is important that a portion of the solution should always be kept on hand, ready for the preparation of the antidote at the moment it may be wanted.

3. SULPHATE OF IRON AND AMMONIA.—FERRI ET AMMONIÆ SULPHAS. *U. S.—Ammonio-ferric Alum.*

This is a new officinal of the U. S. Pharmacopœia, introduced as a substitute for ammonia alum, which it resembles in composition; the sesquioxide of iron being substituted for alumina. Hence it has been called *ammonio-ferric alum*. It is prepared by dissolving a due proportion of sulphate of ammonia in boiling-hot solution of tersulphate of iron, with insufficient water to hold, when the solution cools, the salt formed by their combination. It consists of 1 eq. of tersulphate of sesquioxide of iron, 1 of sulphate of ammonia, and probably 24 eqs. of water $(Fe_2O_3, 3\,SO_3+NH_4O,SO_3+24\,HO)$.

It may be given in the same complaints in which alum is employed, and has been especially recommended internally in leucorrhœa, diarrhœa, chronic dysentery, and other complaints requiring the joint use of astringent, tonic, and chalybeate remedies. The dose is from three to fifteen grains twice or three times daily.

III. SOLUTION OF NITRATE OF IRON.—LIQUOR FERRI NITRATIS. *U. S.*—LIQUOR FERRI PERNITRATIS. *Br.*

Preparation. This preparation, first made known as a remedy by Mr. William Kerr, of Scotland, in 1832, has been adopted as officinal in the U. S. and Br. Pharmacopœias. As made by the process of Mr. Kerr, and according to former officinal directions, by simply dissolving iron wire in nitric acid, with the addition of water to give it a certain strength, it was a solution of the mixed nitrates of the protoxide and sesquioxide of iron, and consequently, on exposure to the air, was apt to become turbid by the further oxidation of the protoxide, and the deposition of a subnitrate of the sesquioxide. Mr. Kerr obviated this effect by adding to the solution a little muriatic acid, which dissolves the sesquioxide as fast as formed. By the present formula of the U. S. Pharmacopœia, which was framed according to suggestions of Prof Procter, it is believed that the difficulty at first experienced has been obviated, and a solution obtained of the nitrate of the sesquioxide of iron without any protoxide whatever. (See *U. S. Dispensatory*, 12th ed., p. 1199.)

Properties. The solution, as made by the former process, is of a dark colour, and apt to become turbid; by the improved method, is of a pale-amber colour and permanent. The taste is ferruginous, acid, and very astringent, but not corrosive. All substances are incompatible with it which form insoluble compounds with sesquioxide of iron, and soluble compounds with nitric acid; consequently, ferrocyanide of potassium, phosphate of soda, and the alkaline sulphurets; and with all the vegetable astringents it affords copious black precipitates. The alkalies and alkaline earths precipitate the base.

Medical Use. This preparation operates like the soluble salts of iron in general; that is, locally as an astringent, and either a moderate excitant or irritant, according to the dose, or the strength of the solution employed; and upon the system at large, as a tonic and reconstructive agent; though, in these latter respects, much inferior to the protosalts of iron, or the metal itself in impalpable powder. It would no doubt prove useful in debilitated states of the stomach and bowels, in the absence of inflammation; and will occasionally cure diarrhœas connected with this condition of the alimentary canal. It was as a remedy in diarrhœa that it was introduced into practice; and much testimony has been adduced in its favour. From the trials I have made with it, I do not consider it superior to the other soluble chalybeates for this purpose, especially the sulphate, when care is taken not to administer that remedy in an overdose. From the experiments of Quevenne, it may be inferred that it must be decomposed and undergo precipitation in the stomach, like the other soluble salts of iron, and consequently does not reach the seat of its operation in the small intestines, in the state of nitrate. The very blackening of the stools is alone evidence of decomposition. The dose is from five to thirty drops, from two to four times a day, which may be gradually increased, if necessary, while borne without inconvenience. In an over-dose it will irritate and inflame, if not corrode the stomach and bowels. It should be borne in mind that the British preparation is about twice as strong as that of our Pharmacopœia; and should not be given in more than half the dose.

The solution has been locally used as an injection in leucorrhœa, diluted so as to produce only a slight smarting sensation; but it is probably inferior, in this and other mucous discharges, to the sulphate of iron, as being less astringent.

IV. PHOSPHATE OF IRON.—FERRI PHOSPHAS. *U. S., Br.*

Phosphate of iron is prepared, according to the directions of our officinal code, by mixing solutions of sulphate of iron and phosphate of soda. A double decomposition takes place, resulting in the formation of sulphate of soda, which remains in solution, and phosphate of iron, which is precipitated. This is then washed and dried. If the salt of iron employed be a pure sulphate of the protoxide, the resulting phosphate will contain the iron in the same condition, and will be white when thrown down; but this almost never happens; and if it do, oxygen will be quickly absorbed, and the salt assume its characteristic colour.

Composition. As employed, this salt always consists of a mixture of the phosphates of the protoxide and sesquioxide of iron, which are in variable proportion. As the phosphoric acid is tribasic, the composition of the protosalt, which greatly predominates, is two equivalents of protoxide of iron, one of water, and one of the acid; that of the sesquisalt, probably one equivalent of sesquioxide, and one of acid.

Properties. Phosphate of iron is a bluish-white powder, nearly tasteless, insoluble in water, but soluble in the acids.

Medical Use. Its operation is that of the insoluble chalybeates generally; that is, it produces the usual effects of the chalybeates on the system, without much affecting the mucous surface of the stomach. It was brought prominently before the notice of the profession by Mr. Carmichael, of Dublin, in his work on cancer, published in 1809, as a remedy in that disease, in which he employed it both internally, and as an application to the ulcerated surface. In a treatise on diabetes, published in 1825, Dr. Venables speaks highly of its usefulness in that disease; and Dr. Prout confirms his favourable estimate, stating that he regards it as an excellent remedy. (*Stom. and Ren. Dis.*, Lond. 1848, p. 50.) The late Dr. Thos. T. Hewson, of Philadelphia, was in the habit of using it for the general purposes of the ferruginous preparations; and, at his recommendation, it was introduced into the Pharmacopœia of the United States. It is no doubt a good chalybeate, capable of doing what can be accomplished by iron in the improvement of the blood, and of the general health, and is thus far useful in cancer and diabetes; but it has no special power over these formidable diseases, and is altogether inadequate to their cure. It is probably in no degree superior to the *pill of carbonate of iron*, if equal to that excellent preparation. The dose is from five to ten grains, which may be given in the form of powder, pill, or electuary. Locally, it may be applied to cancerous ulcers, either by being dusted over them, or in the form of a lotion suspended in water, or mixed with water or glycerin to the consistence of a thin paste, and spread over the surface.

Other combinations of phosphoric acid and oxidized iron have been recommended; but there is probably no one which surpasses the officinal phosphate, either in mildness or efficiency.

1. PYROPHOSPHATE OF IRON.—FERRI PYROPHOSPHAS. *U. S.* Under this name, a preparation of iron has been introduced into the present edition of U. S. Pharmacopœia, consisting of *sesquiphosphate of sesquioxide of iron*, which is insoluble in water, and *citrate of ammonia*, by means of which it is rendered soluble. It is denominated pyrophosphate in the Pharmacopœia, because the acid contained in it is the form of phosphoric acid, disposed to unite with two eqs. of base, and called pyrophosphoric, because produced by the action of heat on the tribasic acid. (See *U. S. Dispensatory.*) The salt is in scales of a greenish colour, and an acidulous somewhat saline taste, and is wholly soluble in water. It is a mild chalybeate, not disagreeable to the taste, and probably capable of being used for the same systemic effects as the other ferruginous preparations, while it has the advantage over several of them that, from its solubility, it may be administered in any desirable form, whether in pills, watery solution, or syrup. The dose is from two to five grains.

2. SYRUP OF PHOSPHATE OF IRON.—SYRUPUS FERRI PHOSPHATIS. *Br.*

Several syrups of phosphate of iron have been proposed. The British syrup contains the phosphate of iron of the Pharmacopœia, dissolved by means of phosphoric acid, and duly incorporated with sugar.

Another syrup proposed by Soubeiran contains the pyrophosphate of iron. A formula for it is contained in the *U. S. Dispensatory* (12th ed., p. 1144). A preparation essentially like it may be made by dissolving the pyrophosphate of iron of the U. S. Pharmacopœia in a little water, and mixing the solution with syrup.

A *compound syrup of phosphate of iron*, called *chemical food*, from the circumstance that it contains many of the mineral constituents of the system, which may be supposed to contribute in this form to its nourishment and support, has been much used in general practice, without having yet obtained officinal sanction. A formula for its preparation will be found in the *U. S. Dispensatory* (12th ed., p. 1143). It is very doubtful whether any material advantage can be obtained from it which may not be obtained from the simple syrup, with such additions as the wants of the system may at any time require; while many of its ingredients must generally be quite superfluous, as the system seldom needs the whole.

The dose of the British syrup is one or two fluidrachms, each containing 3.5 grains of phosphate of iron. By dissolving half a drachm of the U. S. pyrophosphate in a fluidounce of syrup, an equivalent preparation may be made, of which a fluidrachm would be a medium dose.

V. TARTRATE OF IRON AND POTASSA.—FERRI ET POTASSÆ TARTRAS. *U. S.*—FERRUM TARTARATUM. *Br.*—*Tartarated Iron.* Syn. *Ferri Potassio-tartras. Ferrum Tartarizatum.*

This is among the most valuable of the chalybeates. It is prepared, according to the method of Soubeiran, which has been adopted in the U. S. and Br. Pharmacopœias, by adding gradually to a heated mixture of bitartrate of potassa and water, the recently precipitated hydrated sesquioxide of iron (see *page* 443), constantly stirring, until the latter ceases to be dissolved; then filtering, evaporating to the consistence of syrup, and drying in thin layers.

Composition. It is probable that, in the above process, half of the tartaric acid leaves the bitartrate of potassa, and combines with the sesquioxide. According to Soubeiran and Capitaine, the salt contains 30.49 per cent. of the sesquioxide. It may be supposed to consist of one equivalent of tartrate of potassa, and one of basic tartrate of sesquioxide of iron (one eq. of acid and one of base F_2O_3), chemically combined; the latter ingredient probably acting the part of an acid in the compound. But other views have been taken of its chemical nature; and its insensibility to certain reagents which ordinarily act strongly on iron in its soluble forms, would seem to show that its metallic constituent is in a peculiar state of combination.

Properties. As above prepared, the salt is in translucent scales, of a ruby-red colour, and permanent in the air; but, as formerly made, and still frequently found in the shops, it is in the state of a dark-greenish or olive-coloured powder, slightly deliquescent on exposure. The preparation is inodorous, of a mild, sweetish, slightly chalybeate, and not disagreeable taste, freely and wholly soluble in water, slightly so in alcohol, and considerably in diluted alcohol or wine. Its watery solution is not rendered blue by ferrocyanide of potassium, nor precipitated by the alkalies at ordinary temperatures, nor sensibly affected by the ordinary acids. Astringent vegetable infusions, however, affect it in the same manner as other ferruginous solutions.

Medical Use. In one or another form, this chalybeate has long been in use; but is not at present, I think, employed as much as it deserves to be. With little disposition, notwithstanding its solubility, to irritate the stomach, and almost destitute of astringency, it is yet capable of readily imparting its iron to the system, and produces all those effects upon the blood and the tissues which characterize the ferruginous preparations. Without, therefore, being a very efficient remedy in dyspepsia, diarrhœa, or hemorrhages from the primæ viæ, in which it is inferior to other soluble salts, it may be employed with advantage whenever the object is to improve the blood, or produce a tonic impression directly on the system. With a view to these results, and without reference to a specific or peculiar influence of any kind, I should prefer it to all other soluble chalybeates. It may require to be exhibited in a larger dose than they; but, even in equivalent quantities, in relation to the iron it gives to the blood, it is less irritant to the stomach. Another advantage is its less tendency to constipate. Its want of unpleasant taste, as well as its general mildness, admirably adapt it to the cases of young children; and it is wonderful how soon it will restore a healthy colour to their cheeks, in the lowest states of anæmia, when purely functional. The dose for an adult is from ten to thirty grains, three or four times a day, to be given in solution. Three or four grains of it may be given to a child from two to four years old.

Wine of Iron (VINUM FERRI, *Br.*), which is a vinous solution of this salt, has been long in use as a chalybeate. The British Pharmacopœia prepares it by simply dissolving the tartrate of iron and potassa in sherry wine. Formerly the London College directed it to be made by digesting iron wire in sherry wine for a month. The iron was oxidized at the expense of the air or water, and then combined with the excess of tartaric acid of the bitartrate of potassa always present in wine, forming a salt which was probably essentially the same, so far at least as medical effect is concerned, with the one above described. The present plan, therefore, while yielding an equally efficient preparation, is preferable in point of precision; as, by the old method, the strength of the preparation depended on the character of the wine. The preparation is a weak chalybeate, adapted to cases requiring the use of iron, and in which the patient has been in the habit of using wine regularly. It has the advantage over an aqueous solution, of not being liable to the spontaneous decomposition of the organic acid. The dose is from half a fluidounce to two fluidounces, two or three times a day.

VI. TARTRATE OF IRON AND AMMONIA. — FERRI ET AMMONIÆ TARTRAS. *U.S.*

Preparation. This is made, according to the process of Professor Procter, by dissolving freshly prepared hydrated sesquioxide of iron in a solution of bitartrate of ammonia, then evaporating by means of a water-bath, and drying in thin layers, as in the instance of the last-mentioned salt. The equivalent in excess of tartaric acid in the bitartrate unites with an equivalent of the sesquioxide of iron, and a double salt is formed, consisting probably of one equivalent of basic tartrate of the sesquioxide of iron acting as the acid, and one of tartrate of ammonia acting as the base, united, according to Prof. Procter, with four equivalents of water. Or, if tartaric acid be considered as bibasic, with a doubled equivalent, the new salt may be considered as composed of one eq. of tartaric acid and one of each of the bases, and to be, what its name imports, a tartrate of iron and ammonia. When incinerated, the salt leaves 29 per cent. of sesquioxide of iron.

Properties. It is in brilliant, dark-brown, almost blackish scales, or small, irregular, angular fragments, like those of the East India kino; but, by transmitted light, it exhibits a garnet redness. The taste is sweetish, moderately ferruginous, very slightly styptic, and not disagreeable. The salt is very soluble in water. In its reagencies it resembles tartrate of iron and potassa, with which also it is closely analogous in composition, ammonia taking the place of potassa.

Medical Uses. In medical properties, as well as in chemical nature, this salt bears a close resemblance to the preceding; and all that has been said in relation to the tartrate of iron and potassa, of its want of unpleasant taste, general mildness, efficiency as a chalybeate in its operation upon the system at large, and inapplicability to the treatment of stomachic and intestinal affections, belongs equally to this salt. It may be used in any case in which it is desirable to impregnate the system with iron, and in which a soluble preparation is wanted. Another advantage of both these salts is that they may be given with the alkaline carbonates, and generally with other saline medicines, without undergoing decomposition. The dose is from five to thirty grains, three times a day. The first quantity mentioned is sufficient to begin with, unless in urgent cases.

VII. CITRATE OF IRON.—FERRI CITRAS. *U.S.*

The U. S. Pharmacopœia directs this salt to be made by evaporating the officinal *Solution of Citrate of Iron* (LIQUOR FERRI CITRATIS, *U. S.*) to the consistence of syrup, and then spreading it on plates of glass to dry. The solution is prepared by gradually adding to a heated solution of citric acid, freshly precipitated hydrated sesquioxide of iron (see *page* 443) until it ceases to be dissolved, and the acid is saturated. A direct union takes place between the acid and oxide, resulting in the formation of a salt consisting of one equivalent of citric acid, and one of sesquioxide of iron.

Citrate of iron is an uncrystallizable salt, and, as above prepared, is in translucent laminæ of a fine garnet-red colour, of a mild ferruginous taste, slowly soluble in cold, but readily in boiling water.

It is a mild chalybeate, and may be employed to obtain the general effects of iron on the system, either in pill or solution, in doses of from three to ten grains, three times a day. It has been considerably used in this country.

The officinal solution is a convenient form for administration, and may be given in the medium dose of ten minims, equivalent to five grains of the salt.

CITRATES OF THE PROTOXIDE and of the BLACK OF MAGNETIC OXIDE OF IRON have been prepared, but have no special advantage to recommend them.

CITRATE OF IRON AND QUINIA (*Ferri et Quiniæ Citras*, U. S.) is the name given to a preparation made by heating together recently precipitated quinia and officinal solution of citrate of iron, until a solution is effected, then evaporating, and drying upon glass plates. It is in thin, garnet-red scales, of a bitter, slightly chalybeate taste, and soluble in water. It is a double citrate of iron and quinia; but, as usually found in the shops, contains a large excess of the salt of iron. It may be used as a tonic, and would be especially adapted to that anemic condition of system which so frequently follows our autumnal fevers; but I can see no advantage it possesses over a mixture of the citrate of iron with sulphate of quinia, while it has this disadvantage, that the relative quantity of the two salts cannot be adjusted to the particular indications of the case. The dose is about five grains.

VIII. CITRATE OF IRON AND AMMONIA.—FERRI ET AMMONIÆ CITRAS. *U. S.*, *Br.*

Preparation and Composition. This salt is made by mixing officinal solution of citrate of iron and water of ammonia, evaporating at a heat of 150° or less to a syrupy consistence, and then drying on glass plates. The chemical composition of the resulting compound is not exactly determined; but it probably consists of one equivalent of citric acid, one of sesquioxide of iron, and one of ammonia. Mr. Redwood found the salt of commerce to contain variable proportions of the sesquioxide, from 31 to 34.5 per cent. (Pereira, *Mat. Med.*, 3d ed., p. 793.) When the officinal salt is incinerated in the air, it yields 26.5 per cent. of the sesquioxide.

Properties. This salt is in very thin, shining scales, of a bright, almost ruby-red colour, and of a sweetish or acidulous, slightly chalybeate, very feebly styptic, and not disagreeable taste. It is readily soluble in water, but almost insoluble in alcohol. Ferridcyanide of potassium does not change it blue; though with the ferrocyanide it yields a copious blue precipitate, and caustic potassa and lime-water decompose it, throwing down the sesquioxide with escape of ammonia. It is not decomposed by the carbonates of the alkalies. I am told that ammonia escapes when it is heated.

Medical Uses. All that has been said of the medical applications of tartrate of iron and potassa, and tartrate of iron and ammonia, is equally applicable to this salt, which is closely analogous to them in composition and properties. It is an excellent chalybeate, and may be given whenever it is desired to bring the system under the influence of iron, and a soluble preparation is wanted. It is less calculated than some other soluble salts of iron, to meet the indications for the tonic and astringent effects of the chalybeates on the alimentary mucous membrane. The dose is from five to thirty grains, the former being sufficiently large for a commencing dose in ordinary cases.

◆

Several other salts of iron have been recommended at different times, and received more or less attention, of which very brief notices must suffice; as none of them have come into general use, and probably none are capable of producing effects which cannot, to say the least, be quite as conveniently and advantageously obtained from those already described.

1. ARSENIATE OF IRON.—FERRI ARSENIAS. *Br.*

This is an officinal of the British Pharmacopœia, made by mixing solutions of sulphate of iron, and of arseniate and acetate of soda. A white precipitate falls, which soon becomes green on exposure to the air. It is amorphous, inodorous, insipid, and insoluble in water, but is readily dissolved by muriatic acid; and, when first formed, consists of three eqs. of protoxide of iron and one of arsenic acid. On exposure, however, the protoxide absorbs oxygen, and the preparation, therefore, contains a portion, though indefinite, of the sesquioxide. It has been introduced into use, under the idea that it might exercise upon the system the combined virtues of arsenic and iron. It is in fact useful in cutaneous affections, such as yield to arsenic; but the proportion of iron contained in it is too small to be of account; and this salt must be regarded simply as arsenical. In this respect, I know no superiority which it possesses over Fowler's solution. The dose is from the eighth to the tenth of a grain, which may be given in the form of pill three times daily.

2. ACETATE OF IRON.—FERRI ACETAS.

Acetate of protoxide of iron is in small, green crystals, which decompose rapidly on exposure to the air; acetate of sesquioxide of iron is uncrystallizable, and, in the solid state, deliquescent; it is only, therefore, in solution that either of these salts can be conveniently kept. The Dublin Pharmacopœia directed a *Tincture of Acetate of Iron* (TINCTURA FERRI ACETATIS), which was made by mixing alcoholic solutions of the sulphate of sesquioxide of iron and acetate of potassa. A double decomposition took place, resulting in the formation of sulphate of potassa, which was precipitated, and acetate of sesquioxide of iron, which remained in solution. The liquid was then expressed and filtered. The tincture thus made is transparent, of a deep-red colour, and a strong, ferruginous taste. It is an agreeable and efficacious chalybeate, and was a favourite with Dr. Percival, who is said to have introduced it into the Dublin Pharmacopœia. In this country, it is seldom or never used. The dose is from twenty minims to a fluidrachm.

3. CITRATE OF IRON AND MAGNESIA.—FERRI ET MAGNESIÆ CITRAS.

This is made by dissolving freshly prepared hydrated sesquioxide of iron in citric acid, saturating with carbonate of magnesia, evaporating to the consistence of syrup, and drying in thin layers. It is in translucent scales, of a greenish-yellow colour, and an acidulous, slightly chalybeate taste, very soluble in water, but insoluble in alcohol. It has the general properties of the ferruginous preparations, and may be given in the dose of five grains or more, in pill or solution.

4. LACTATE OF IRON.—FERRI LACTAS. *U. S.*

Under the impression that lactic acid is ordinarily present in the gastric juice, that it is consequently the form of lactate which the ferruginous preparations introduced into the stomach generally assume, and that in this form they enter the circulation, MM. Gélis and Conté were induced to recommend the use of the lactate of iron in medicine, as more likely than other chalybeates to find its way readily into the blood, and to produce the required effects on the system. Some trials that were made confirmed their views as to the efficiency of the salt, and it was for a time considerably used; but further experience has shown that it is not superior to other salts of iron; and, from the experiments of Quevenne, it would appear that it is no less liable than others to undergo precipitation in the stomach.

It may be made either, as directed in the U. S. Pharmacopœia, by digesting iron filings in lactic acid, or by double decomposition between lactate of lime and sulphate of iron. In the former case, the iron is protoxidized at the expense of the water, and then combines with the acid to form a lactate of the protoxide; in the latter, the same salt remains in solution after the precipitation of sulphate of lime. The lactate may be obtained from the solution in crystals in the ordinary mode, or in the form of scales by evaporating to the consistence of syrup, and then spreading thinly on glass or porcelain to dry.

Lactate of protoxide of iron is in greenish-white crystalline grains or crusts, of a mild ferruginous taste, little changed on exposure to the air, slowly and sparingly soluble in water, and scarcely soluble in alcohol. The watery solution becomes yellowish on exposure, in consequence of the partial sesquioxidation of the protoxide; and the dry salt is sometimes met with of the same colour, probably from the same cause, or from want of care, in its preparation, to avoid this source of impurity.

In its effects on the system, lactate of iron is not unlike the sulphate, but is less astringent. It is capable of exciting, and, in over-doses, of irritating the stomach, and may, therefore, be used as a gastric stimulant in dyspepsia, though less efficient than some others in diarrhœa, and hemorrhage from the mucous membrane of the primæ viæ. It may also be employed to produce the effects of iron on the system at large; but is inferior for this purpose to powdered iron, or the pill of the carbonate, or even to the milder soluble salts, as the tartrate of iron and potassa, and the tartrate or citrate of iron and ammonia, because more liable to irritate the stomach when freely administered, and consequently incapable of imparting so much iron to the circulation within a given time. The dose is one or two grains, three times a day, which may be gradually increased so as to amount to twelve grains daily. It may be given in powder, pill, or syrup.

5. VALERIANATE OF IRON.—Ferri Valerianas. *Dub.*

This preparation was introduced into the Dublin Pharmacopœia, probably under the impression, that the valerianic acid contained in it might superadd to the tonic action of the iron, in chlorotic cases, the peculiar antispasmodic influence of the oil of valerian. It is, however, so easy to mix a little oil of valerian with one of the preparations of iron, that, even admitting the peculiar additional virtue supposed to be acquired, it is scarcely a sufficient reason for increasing the already overburdened catalogue of the chalybeates. Accordingly, the preparation has been omitted in the Br. Pharmacopœia. The salt is made by double decomposition between the sulphate of sesquioxide of iron and valerianate of soda; sulphate of soda being left in solution, and valerianate of sesquioxide of iron precipitated. The latter is then washed, dried, and kept in well-stopped bottles. The salt is composed of three equivalents of acid and one of sesquioxide. It is in the form of a loose, dark-red powder, with a slight odour and taste of valerianic acid, insoluble in cold water, soluble in alcohol, and deprived of its acid by boiling water. It is also decomposed by the acids, which liberate valerianic acid, recognizable by its peculiar, very offensive odour. The preparation is thought to be specially adapted to anemic cases associated with hysteria. One grain is mentioned as the dose, to be repeated three or four times a day.

4. *Preparations of Iron in the State of Haloid Salts.*

I. CHLORIDE OF IRON.—FERRI CHLORIDUM. *U. S.*—*Sesquichloride of Iron. Perchloride of Iron.*

This is properly the sesquichloride or perchloride of iron. Though long and very largely used in alcoholic solution, and more recently, to a considerable extent, dissolved in water, this chalybeate has until of late never been kept in the dry state, and was for the first time introduced into the U. S. Pharmacopœia at the last revision. It is prepared by first treating iron wire with muriatic acid, by which the protochloride is produced in solution; then bringing this to the state of sesquichloride by adding nitric acid, and a further quantity of muriatic acid, to the heated solution; and lastly evaporating and crystallizing The simplest explanation of the process is that, in the first step, iron attracts sufficient chlorine from the muriatic acid to convert it into the protochloride, while the hydrogen of the acid escapes with effervescence; and, in the second, the nitric acid gives up a portion of its oxygen to the hydrogen of the muriatic acid in excess, thereby liberating enough chlorine to bring the protochloride of iron to the state of the sesquichloride.

Thus procured, the chloride of iron is in crystalline fragments, of an orange-yellow colour, inodorous, of a strongly styptic and ferruginous taste, very soluble in water, deliquescent, and soluble in alcohol and in ether. It consists of two eqs. of iron and three of chlorine, and is represented by the formula Fe_2Cl_3, with a variable quantity of water of crystallization. That it is a sesquichloride of iron, containing no protochloride, is proved by its affording a blue precipitate with the ferrocyanide, but none with the ferridcyanide of potassium. The only objection to it in the solid state is its liability to deliquescence, which can be guarded against by keeping it in accurately closed bottles. It undergoes no change on exposure. There are two officinal preparations of it; the tincture, which is chiefly employed internally; and the watery solution, which is used locally. It has been employed as a local styptic in a semi-deliquesced state, and found to be extremely efficient. For this purpose, Mr. J. Z. Lawrence keeps it in a bottle loosely closed, and, as it deliquesces, applies the thick liquid portion, by means of a spun-glass brush, to bleeding surfaces. MM. Jodin and Aubrun, of Paris, have used it internally in pseudomembranous croup, with great asserted success, giving it in quantities varying from ninety grains to half an ounce, in divided doses, very frequently repeated, in the twenty-four hours. (*Ann. de Thérap.*, 1861, p. 201.) But these I should consider as very hazardous doses, and justifiable only under desperate circumstances. The solid sesquichloride has proved an efficient remedy in that obstinate and painful ulceration about the toe-nail, resulting from the pressure of the edge of the nail upon the flesh. The powder is introduced beneath the protruding flesh, and sprinkled on its surface. The pain quickly subsides, and the patient is able to walk in a few days. (*Bost. Med. and Surg. Journ.*, Oct. 22, 1863, p. 240.)

1. **TINCTURE OF CHLORIDE OF IRON.**—TINCTURA FERRI CHLORIDI. *U. S.*—TINCTURA FERRI PERCHLORIDI. *Br.*—FERRI MURIATIS TINCTURA. *Ed.*—*Muriated Tincture of Iron.*

Preparation. This was formerly prepared by dissolving subcarbonate of iron (U. S.) in muriatic acid, and, after filtration, adding alcohol to the solution. As the subcarbonate of iron of the U. S. Pharmacopœia consists mainly of sesquioxide of iron, and this, by reaction with muriatic acid, is converted into sesquichloride, there is obtained by this process a solution of sesquichloride of iron in alcohol, with only so much water as was contained in the muriatic acid used. But there is usually, in the subcarbonate above referred to, a small, though uncertain proportion of carbonate of protoxide of iron, producing with the muriatic acid a corresponding proportion of protochloride, which remains in the solution. But protochloride of iron, exposed to the air, is converted, by the absorption of oxygen, into sesquichloride and sesquioxide, the latter of which, being insoluble, has a tendency to render the preparation turbid. If there be an excess of muriatic acid present, it will dissolve the sesquioxide as fast as formed, and thus preserve the liquor clear; but, as this was not the case in the old U. S. formula, the tincture was apt to become turbid on standing. A precipitate was slowly produced, which formed crusts on the bottle, and in this state was insoluble in an excess of muriatic acid, probably from its peculiar state of aggregation.* Another inconvenience incident to the preparation was that, in consequence of the muriatic acid of the shops falling short of the officinal sp. gr. 1.16, the whole of the subcarbonate directed was not dissolved, and the resulting tincture was, therefore, too weak. If the strong acid could not be obtained, this defect might be obviated, as suggested by Mr. A. P. Sharp, of Baltimore, by passing a little muriatic acid gas, from some liquid muriatic acid heated in a Florence flask, through a bent glass tube, into the mixture of the subcarbonate and acid, until a perfect solution was effected, and then proceeding as directed in the officinal process. (*Am. Journ. of Pharm.*, xxvii. 103.)

But most of the disadvantages above mentioned have been obviated in the new process adopted in the present Pharmacopœia, in which a pint of aqueous solution of the sesquichloride is first made by the successive action of muriatic and nitric acids on iron wire, as in the process for preparing the solid sesquichloride; and three pints of alcohol are then added. But, in order to obtain satisfactory results even with this method, it is necessary in the first place to be provided with materials pure and of due strength, and then faithfully to carry out all the directions. (See *U. S. Dispensatory.*)

Properties. The tincture of chloride of iron is a deep-brown liquid, which, in very thin layers, is yellowish, and, applied to white paper, produces a yellow stain. It has a sour, very astringent, and strongly chalybeate taste, and an odour resembling that of muriatic ether, a little of which is probably generated by reaction between the muriatic acid and alcohol. It should have the sp. gr. 0.990; and a fluidounce of it should yield when diluted, and precipitated with ammonia, an amount of sesquioxide of iron weighing, after being washed, dried, and ignited, 29 grains. It is sensible to the ordinary tests for iron. The following substances produce precipitates with it; namely, the alkalies, alkaline earths and their carbonates, acetate and subacetate of lead, nitrate of silver, astringent vegetable infusions, and mucilage of gum arabic.

Effects on the System. This preparation is locally excitant and astringent, and, in excess, highly irritant. Swallowed in moderate doses, it acts as a tonic and astringent upon the alimentary canal, increasing the appetite, promoting digestion, and causing constipation of the bowels. More largely used, it irritates the stomach, and, in great excess, acts as a poison by inflaming the gastric and intestinal mucous membrane. Christison, in his treatise on poisons, mentions a case in which death appeared to result from swallowing a fluidounce and a half of the tincture. There were symptoms of inflammation in the stomach and bowels during life, and the marks of it after death. Upon the system in general it produces the ordinary effects of the chalybeates, and is thought, moreover, by some, to operate as a diuretic, and to exert a peculiar influence on the urinary organs. Though I have used the medicine considerably, I have not noticed the latter effects, but I do not wish to be understood as denying them. Attention has recently been called to an extraordinary power of coagulating the blood, possessed by a strong watery solution of the sesquichloride, when injected into the blood-vessels; and the tincture would probably have a similar effect.

---

* Prof. Procter ascertained, at my request, that this precipitate was not an oxychloride of iron, for it was dissolved by sulphuric acid without the evolution of muriatic acid. It was, therefore, probably sesquioxide, rendered, as suggested in the text, insoluble in excess of muriatic acid by its peculiar molecular condition.

Therapeutic Application. The tincture may be used with advantage as a tonic in dyspepsia, and a joint tonic and astringent in diarrhœa of relaxation, and in passive hemorrhage from the stomach and bowels. It may also be used with a view to bring the system under the influence of iron, and is with many a favourite remedy for this purpose; but it has the disadvantage of being liable to irritate the stomach, if given somewhat too freely; and is inferior, I think, for this purpose, to the powder and carbonate, and to the milder soluble salts, as the double tartrate, or ammonio-citrate. There are, however, special purposes which it may be better calculated to fulfil than those preparations. Through the chlorine in its composition, it has been considered as having alterative properties, which render it more efficient in scrofula than the chalybeates generally; and it has, therefore, been associated with other chlorides, as those of barium, calcium, and sodium, in the treatment of that affection, when complicated with anæmia. It is supposed also to be more efficacious than most of the chalybeates, in checking hemorrhage from the uterus and urinary passages. It has, indeed, enjoyed considerable reputation, in consequence of the special influence ascribed to it over the urinary organs. In anemic cases of dropsy, in which chalybeates are indicated, it might be selected preferably to others, from its supposed possession of diuretic powers. It is also well adapted to those cases of anæmia, in which there is a coexisting indication for nitromuriatic acid, as in the form of cachexia attended with copious formation of oxalate of lime in the urine. I have seen this combination very speedily successful under such circumstances. Some surgeons of eminence have found it peculiarly efficient in spasmodic stricture of the urethra, in which it must be used more freely than for other purposes; ten minims being given every ten minutes until it produces the desired effect or nauseates. It has also been recommended in dysury from weakness of the muscular coats of the bladder, in chronic mucous discharges from the same viscus, and from the pelvis of the kidney, in leucorrhœa, gleets, and the advanced stages of gonorrhœa. A very natural explanation of the efficacy of this tincture in diseases of the urinary passages was that, being eliminated along with the urine, it came in contact with the interior surface of the passages, and produced its effects by an immediate action on the seat of the disease; but Dr. A. H. Hassall, of London, has satisfactorily determined, by repeated experiments, that neither the chloride itself, nor either of its constituents, passes out with the urine; and this explanation, therefore, must be abandoned. (*Lancet*, Dec. 1864, p. 740.) But the absence of the tincture from the passages is no proof that it may not act directly on the diseased tissue; for, if it circulates with the blood, it comes really more closely into contact with the tissue than if merely passing over the outer surface of it; and, if it has any special relation to these organs, it thus has the opportunity of exercising its full influence on them.

A new application has, within a few years, been made of the tincture by Mr. C. Hamilton Bell, of Edinburgh; to the treatment, namely, of erysipelas. He gives it internally, in doses of from fifteen to twenty-five drops every two hours, continued night and day, throughout the complaint, employing no other treatment, except to operate freely on the bowels in the beginning, and afterwards to keep them regularly open. At the time of his published notice, he had used the remedy for twenty-five years, with invariable success. (*Ed. Month. Journ. of Med. Sci.*, A.D. 1851, p. 498.) Other practitioners have employed the remedy, and reported favourably of its effects. I have myself used it in many cases, which all terminated in health at the usual period; though the same result might possibly have happened under other modes of treatment; for, within my observation, this complaint has almost always ended favourably, unless in individuals previously broken down by intemperance or disease. Still, after so uniformly favourable an experience, running through several years of hospital practice, I cannot but think that there is real efficacy in the remedy.

Dr. H. L. Byrd, of Savannah, Geo., has employed a similar treatment, with great supposed advantage, in scarlet fever, and considers the remedy, from his experience with it in twenty cases, as superior to all others in that complaint. He gave it in doses varying according to the age, from half or three-quarters of a drop for an infant six or seven weeks old, to ten drops for a child eight years old, and at intervals varying from four to eight hours. (*Charleston Med. Journ.*, ix. 165, March, 1854.)

The tincture has also been given, with supposed benefit, in pseudo-membranous angina, or epidemic diphtheria, in which the blood is believed to be depraved in a manner somewhat analogous to that which characterizes erysipelas.

It has also been recommended as especially efficacious in purpura hæmorrhagica.

The dose of the tincture for ordinary purposes is from ten to thirty minims, which may be increased to one or two fluidrachms, two or three times a day.

Externally the medicine has been employed as a stimulant and astringent application to venereal warts, and cancerous and fungous ulcers; and as a styptic to bleeding surfaces.

2. SOLUTION OF PERCHLORIDE OF IRON.—LIQUOR FERRI PERCHLORIDI. *Br.*

A strong solution of perchloride of iron having come into extensive use as a styptic, the British Pharmacopœia adopted it as officinal, and gives a process for its preparation. Unfortunately, however, from certain defects in the formula, the resulting preparation is not a pure solution of the sesquichloride of iron, but contains also a portion of the protochloride and an excess of nitric acid. The preparation was not adopted in the U. S. Pharmacopœia; because, directions having been given for preparing the solid sesquichloride, nothing more is necessary to prepare a solution of any desired strength than simply to dissolve this in water.

When properly made, the solution has an orange colour, and a strongly ferruginous and styptic taste. It unites with water and alcohol in all proportions. The strength of the British solution in sesquichloride is probably about four times that of the U. S. tincture of the chloride.

Medical Properties and Uses. This preparation is used almost exclusively as a local styptic; a property which it owes mainly to its extraordinary power of coagulating the blood. M. Pravaz, a surgeon of Lyons, in France, found that, through the influence of a few drops of it thrown into an artery or vein, all the blood for an extent of somewhat more than an inch, was coagulated, in the course of a few minutes, into a firm clot. It has been employed especially in the treatment of varices and aneurismal tumours. In the cure of varices, it is asserted to have proved among the most efficient remedies known. For this purpose, a solution has been recommended containing about one part of the salt to two parts of water, for aneurisms about one part to four. But this operation is not without danger; as cases are on record of death from its injection into nævi of the face in infants, consequent on the direct passage of the solution through a vein of the nævus into the heart, where the blood was coagulated. Caution, therefore, is necessary, in performing the operation, to introduce the solution very slowly. (*Med. T. and Gaz.*, June, 1864, p. 683.) It has also been used to check hemorrhages in surgical operations, applied upon pledgets of lint, and for the cure of panniform keratitis, being for this purpose dropped into the eye. (See *N. Am. Medico-chirurg. Rev.*, i. 117.) It is said to effect the cure of hemorrhoids, applied to them after blistering. Solutions of various strengths, to suit special purposes, may be made by dissolving six, three, two, and one and a half drachms in a fluidounce of distilled water.

The British solution may be given internally in the dose of from two to ten minims. Applied locally to certain obstinate cutaneous affections, as eczema, lichen agrius, etc., it is said in some instances to have effected speedy cures.

Perchloride of iron is one of the substances of which the solution has been used, in the form of spray, by means of the atomizer. It may be employed in this way in diphtheric affections and chronic inflammations of the air-passages, and in pulmonary hemorrhage. The strength of the solution, in ordinary chronic inflammation, may be from half a grain to two grains to the fluidounce of water; for diphtheria and hemorrhage from two to ten grains.

II. AMMONIATED IRON. — FERRUM AMMONIATUM. *U. S.* 1850.—*Ammonio-chloride of Iron.*

When the subcarbonate of iron of the U. S. Pharmacopœia (sesquioxide of iron) is digested with muriatic acid, a reaction takes place, by which the sesquichloride of iron is formed in solution. If now a solution of muriate of ammonia be added, and the mixed liquids evaporated to dryness, we obtain the preparation under consideration. It is probably nothing more than a mixture of sesquichloride of iron and muriate of ammonia, the former amounting only to about 15 per cent.

Ammoniated iron is in crystalline grains of a fine reddish-orange colour, and sharp saline, and chalybeate taste. It is deliquescent, and soluble in water and alcohol. Its incompatibles are the same as those of the preceding article.

Under the name of *flores martiales* or *martial flowers*, a preparation closely analogous to this has long been known, since the times, indeed, of Basil Valentine, which was prepared by subliming a mixture of sesquioxide of iron and muriate of ammonia. The sesquioxide was probably converted, at the expense of a part of the muriatic acid of the muriate of ammonia, into sesquichloride of iron, which then chemically combined with the remainder of the muriate. The preparation differed from that now officinal in having a yellow colour, and a slight peculiar odour.

Medical Uses. The great predominance of the muriate of ammonia renders this a feeble chalybeate, while it imparts aperient, and, as some suppose, alterative properties, which give it a somewhat peculiar character. It is particularly applicable to cases which offer indications at once for the influence of iron and of a deobstruent agent. Such are presumed in anemic states of the system with swollen lymphatic glands as in scrofula, with enlarged liver, or with chronically hepatized lung. At present, however, it is little used; and it is no longer officinal, having been abandoned both in the U. S. and Br. Pharmacopœias. The dose is ten or twelve grains to begin with, which may be given in pil solution, or electuary. The London College directed a tincture, which, being a useless preparation, has been omitted in the British code.

III. IODIDE OF IRON.—FERRI IODIDUM. *Br.*

Preparation. Iodide of iron is prepared by simply mixing the two ingredients together, with the presence of water, which dissolves the resulting compound, and, after filtration, yields it by evaporation. The iron is employed in the state of filings, or of wire; but the latter is preferable, as it is in general purer. The preparation consists of one equivalent of iron, one of iodine, and five of water; but, if considerable heat is employed in drying it, the proportion of water is smaller. It should be kept in a well-stopped bottle.

Properties. When the solution of iodide of iron is very carefully evaporated, with the exclusion of atmospheric air, the salt is obtained in the form of green, transparent, tabular crystals; but, as ordinarily prepared, it is a greenish-black substance, of an astringent chalybeate taste, very deliquescent, and very soluble in water and alcohol. At a moderate heat it melts, and on cooling solidifies into a dark-gray, crystalline mass, of a metallic lustre. At a higher heat, with exposure to the air, it is decomposed; the iodine escaping, and the iron absorbing oxygen, and remaining behind as the sesquioxide. Upon the slightest exposure to the air, even at ordinary temperatures, the iron attracts oxygen and passes into the state of sesquioxide, while the iodine becomes free. Analogy would lead to the supposition that, as in the case of the protochloride of iron, the metal would be divided between the oxygen absorbed, and the principle previously combined with it, forming the sesqui-iodide and sesquioxide; but that iodine is liberated is shown by the fact, that the altered substance colours starch blue. This change has almost always happened, in some degree, with the iodide of iron of the shops, which, on that account, is seldom entirely soluble in water.

A solution of the iodide undergoes this change much more rapidly than the solid salt, quickly depositing the sesquioxide, and thus becoming weakened as a chalybeate. There are, however, two means of protecting the solution against this change; one by introducing into the bottle containing it some iron filings, or a coil of iron wire, the other by incorporating it with a considerable proportion of sugar. A solution protected in the latter method is officinal, and will be described. In the former method, the free iron immediately takes all the oxygen which that of the iodide absorbs from the air; and the protiodide, therefore, remains unchanged in the solution.

Incompatibles. Precipitates are produced in the solution of iodide of iron by the alkalies and their carbonates, lime-water, magnesia, soaps, hydrosulphuric acid and the soluble sulphurets, ferrocyanide of potassium, the soluble salts of lead, copper, silver, and mercury, but not those of zinc, by the soluble phosphates, all the astringent vegetable infusions, and many other organic substances.

Effects on the System. Iodide of iron has both the topical and constitutional effects of the other soluble salts of the metal, increasing the appetite, improving digestion, enriching the blood, and operating generally as a tonic; but it is less astringent than the sulphate, and probably less so than the nitrate or chloride; and, moreover, possesses peculiar properties quite distinct from its powers as a chalybeate, and attributable to the iodine it contains. These are evinced in its alterative, diuretic, and laxative effects. Dr. A. T. Thompson states that, shortly after its administration in large doses, both iron and iodine may be found in the urine; but it is not mainly in the form of iodide of iron that it is thus thrown off. The experiments of Quevenne show that but a small portion of the metal passes by the kidneys, while the iodine passes abundantly; proving that the two constituents are separated in the system, and most of the iron retained. (*Arch. de Physiol. de Bouchardat*, Oct. 1854, p. 104.) We can thus explain the two classes of effects produced, one belonging to the chalybeate ingredient, the other to the iodine. In over-doses, iodide of iron proves irritant to the stomach and bowels, causing epigastric uneasiness, nausea, vomiting, purging, and griping pains. Very largely taken, it would probably induce serious gastro-intestinal inflammation; though I have seen no account of positively poisonous effects.

Therapeutic Application. This medicine was first employed by Dr. Pierquin so early as in the year 1824. It is now among the most popular of the chalybeates, though employed chiefly in a special class of cases. It may be used as a gastric tonic in dyspepsia, or with a view to the general effects of iron on the system, as in simple chlorosis, or in the anemic condition attended with amenorrhœa, leucorrhœa, etc.; but its best effects are displayed in cases of scrofulous disease, and other forms of local tumefaction or induration, in which there is at the same time an indication for the improvement of the blood. It is only in the absence of all febrile excitement and gastric inflammation, that it should be resorted to in such cases; but, when properly accommodated to the state of the system, it is an excellent remedy. In swellings of the lymphatic glands external or internal, diseases of the bones, ligaments, and joints, and ulcerative and eruptive affections of the skin, when these can be traced to a scrofulous taint; in chronic enlargement of the thyroid gland, mamma, testicle, ovary, liver, and spleen; in various subacute or chronic swellings and indurations without special seat, or known peculiarity of character; in all these affections, it may be considered as indicated when they exist conjointly with an anemic state of the blood, and a general deficiency of vital force. Without this associated condition, and in all cases in which the excitant properties of the chalybeate on the system may be contraindicated, some other preparation of iodine, especially iodide of potassium, should be preferred. Iodide of iron has also been used with advantage in secondary syphilitic affections, in like manner connected with anemic debility. It is said, moreover, to have been successfully employed in diabetes. A solution of it containing from one to two drachms in a pint of water, has been employed locally as an injection in gonorrhœa and leucorrhœa, and as a lotion in ulcers.

Administration. The dose of iodide of iron is two or three grains three times a day, which may be increased to ten grains, if not found to disturb the stomach. The administration of it, in the pilular form, is attended with some difficulty, in consequence of its deliquescent property, and extreme proneness to chemical change. Various modes of obviating these objections have been proposed Perhaps the best method would be to evaporate to a pilular consistence the officinal solution of the iodide, which is protected from change by sugar; or the preparation might be directly incorporated with sugar when made into pills; or, as suggested by Prof. Procter, a little reduced iron might be added to the mass with the same view. But, even though protected against oxidation, the pills would still be liable to deliquescence. To obviate both disadvantages, they might be covered with a coating of impervious matter, by dipping them into a chloroformic solution of caoutchouc and drying them. It will be noticed, in the following paragraph, that these suggestions have been carried into effect in the recent revision of the U. S. Pharmacopœia, even to the impervious coating, though the material for coating the pills is not the one here proposed, and is probably preferable to it.

Pills of Iodide of Iron (PILULÆ FERRI IODIDI, *U. S.*) are ordered by our officinal code to be made by first forming the iodide in strong solution by a direct combination of the two ingredients, then incorporating the solution with a little reduced iron, sugar, and marshmallow in powder, and finally evaporating to a pilular consistence, and dividing into pills. These are directed to be coated with balsam of Tolu, which to a considerable extent preserves them from the injurious influence of the air, while the reduced iron and sugar still further protect them from the oxidation of the iron. Each pill contains about a grain of the iodide of iron and one-fifth of a grain of reduced iron. Two or three of them may be taken two or three times a day.

Syrup of Iodide of Iron (SYRUPUS FERRI IODIDI, *U. S.*, *Br.*).—*Solution of Iodide of Iron* (LIQUOR FERRI IODIDI, *U. S.* 1850). This is directed by the U. S. Pharmacopœia to be prepared by dissolving iodine and iron filings together in water, filtering the solution into a certain proportion of syrup, in a bottle, previously heated to 212°, and then adding sufficient syrup to produce the requisite measure. This preparation differs from the *solution of iodide of iron* of the U. S. Pharmacopœia in having a larger proportion of sugar, which was needed for its preservation, and which is now sufficient to authorize the preparation to be placed among the syrups. It is on the whole the most convenient form for the administration of iodide of iron.

The syrup is transparent, and of a pale-green, or yellowish-green colour, and without sediment. By exposure to light, in a closely stopped bottle, it becomes nearly colourless. It is the common form for the administration of iodide of iron, and is greatly preferable to the pill. When it is swallowed, care should be taken to wash out the mouth well, in order to avoid possible injury to the teeth. The dose of the U. S. preparation is from twenty to forty minims, which should be diluted with water, but only at the moment of exhibition.

IV. FERROCYANIDE OF IRON.—FERRI FERROCYANIDUM. *U. S.—Pure Prussian Blue.*

Preparation. As the Prussian blue of commerce is always more or less impure, this preparation should be made specially for medical use. The U. S. Pharmacopœia directs that to the officinal solution of tersulphate of iron a solution of ferrocyanide of potassium should be added, and that the precipitate produced should be washed on a filter, and dried. Portions of the iron of the tersulphate, and of the potassium of the ferrocyanide, change places, so as to form sulphate of potassa and ferrocyanide of iron, of which the former either remains in the solution, or is dissolved out in the washing, leaving the latter pure.

Composition. Ferrocyanide of iron consists of three equivalents of ferrocyanogen (which contains one equivalent of iron and three of cyanogen), four equivalents of iron, and six eqs. of water; the last ingredient being essential; as it cannot be separated without decomposing the salt. The compound, however, as in the case of other haloid salts, may be looked on as consisting of a hydracid and an oxide of iron, the hydrogen of the water going to the ferrocyanogen, and the oxygen to the iron. In this view, the salt would be a hydroferrocyanate of the sesquioxide of iron, and would consist of three eqs. of hydroferrocyanic acid (each containing one eq. of ferrocyanogen and two of hydrogen), and two eqs. of sesquioxide of iron. *Commercial Prussian blue* always contains, besides the above compound, a portion of uncombined alumina and sesquioxide of iron.

Properties. The pure salt is in the form of a rich deep-blue powder, inodorous and tasteless, insoluble in water and alcohol, and unaffected by the dilute acids. Strong sulphuric acid dissolves without decomposing it, concentrated nitric and muriatic acids decompose it, and the alkalies separate sesquioxide of iron.

Effects on the System. From the insipidity of Prussian blue, its insolubility even in dilute acids, and the fact that it is formed whenever ferrocyanide of potassium meets a salt of iron in the body, even in the circulating liquor sanguinis, a fair inference is, that it would probably have no other effect on the system than such as might result mechanically from the presence of an insoluble powder in the stomach and bowels; and this view would seem to be supported by the experiments of M. Coullon, who found it without action in several different species of animals. (*Merat et De Lens*, ii. 531.)

Therapeutic Application. Notwithstanding, however, its presumed inertness, it has been much commended by some practitioners. Dr. W. Zollickoffer, of Maryland, first called the attention of the profession to it as a remedy in *intermittent and remittent fevers*, in which he was induced by his observations to consider it superior to Peruvian bark. (*Am. Med. Recorder*, July, 1822, v. 540.) Dr. Samuel Jackson, late of Northumberland, employed it with success in a large number of cases, but found it to fail in many. (*Am. Journ. of Med. Sci.*, ii. 336, A.D. 1827.) Dr. Hasse, a German physician, found it effectual in an epidemic intermittent which prevailed at Gastrow in the spring of 1827; but he gave doses of a grain of the salt with a scruple of pepper, the latter of which was probably much the more efficacious of the two. (*Hufeland's Journ.*, quoted by *Merat and de Lens*, ii. 531.) Dr. Eberle speaks of it favourably from his own observation and experience. (*Mat. Med. and Therap.*, 4th ed., i. 321.) Many other physicians have borne a somewhat hesitating or equivocal testimony in its favour. I tried it myself in a number of cases, soon after it first came into notice, with some success, but with so many failures that I soon abandoned it. The medicine has been given with supposed success also in *chorea* and *epilepsy*, but associated generally with others, so as to leave the real agent of cure doubtful, and sometimes in such doses as to leave no doubt as to the inefficiency of the Prussian blue. Thus, M. Burguet, of Bordeaux, gave from one-eighth of a grain to four grains a day; and Dr. Kirckhoff, of Ghent, supposed that he cured epilepsy with from half a grain to six grains in the day. Dr. Bridges, of Philadelphia, employed it in a case of obstinate *facial neuralgia*, with considerable relief, after the ordinary remedies had been tried with little or no effect. It will have been observed that all these diseases, in which efficiency has been claimed for it, are of a character to be readily affected through the mind; and in which anything will occasionally effect apparent cures in which the patient may have confidence, or even strong hope. I am not prepared, however, to say, that the mere presence of an insoluble agent in the primæ viæ, acting only mechanically on the mucous surface, may not prove useful in nervous diseases, and local affections of the membrane itself.

The dose, as given by different practitioners, varies extremely. Generally, from four to six grains have been given several times a day. Instances are mentioned above in which the dose was reduced to the eighth of a grain, and Dr. Jackson, late of Northumberland, gave in some cases two drachms during the interval in intermittents, finding it to lie easily on the stomach. This latter fact tends strongly to favour the idea of its inertness, in reference to any direct influence on the system in general.

* * *

Besides the preparations of iron, other substances have been to a certain extent remedially employed, under the impression that they might supply deficiences, in the system, of certain constituents derived from the mineral kingdom.

Manganese, having been found in the blood, has been like iron supposed to constitute a normal ingredient of that fluid; and, under this impression, has been used in certain conditions of anæmia as an adjuvant of the chalybeates, or a substitute for them. At one time the compounds of this metal were considerably prescribed; but, with one exception, the *permanganate of potassa*, they have fallen into comparative neglect; and this owes its importance to quite other properties than those of a reconstructive tonic. This salt will be treated of with the *Disinfectants;* and I may then take occasion to allude to some other preparations of this metal; but, for a full account of them, the reader is referred to the U. S. Dispensatory.

Phosphate of Lime has been supposed to be useful in certain cases of diseased bones, by supplying a deficiency of earthy matter, as in rickets, scrofulous affections of the bones, etc.; but it is not, I believe, the deficiency of material that here constitutes the difficulty, so much as the power of assimilating them; and phosphate of lime is probably almost always sufficiently supplied with the food. Nevertheless, it may be used without disadvantage, even if productive of no great benefit. It has been adopted in the U. S. Pharmacopœia, under the title of *Precipitated Phosphate of Lime* (*Calcis Phosphas Præcipitata*, U. S.), and directions are given for preparing it from calcined bones. (See *U. S. Dispensatory*, 12th ed.) It is a white, inodorous, tasteless powder, insoluble in water, but readily dissolved by diluted nitric, muriatic, and acetic acids. The acid being tribasic, it consists of three eqs. of lime and one of phosphoric acid. Beneke has suggested its use in diseases of defective nutrition, as scrofula, phthisis, etc., from the circumstance that it is an ingredient in the ultimate cells; but the same reason for doubt exists here as in the former case of diseased bones; it is not the material, but the assimilating power that is wanting; for, in many of these cases, the insoluble phosphates are discharged in excess by the kidneys, showing that there is no deficiency of them in the blood. The dose is from ten to thirty grains. It may be given in powder, or dissolved in water, with the aid of a little muriatic or nitric acid, which will often probably greatly add to its efficiency.

Hypophosphites. On the same view of supplying a supposed deficiency of material in the system, the hypophosphites have been employed to furnish phosphorus to the tissues; and with this object have been especially recommended in the treatment of phthisis. Experience, however, has shown their entire want of control over this disease; and there does not appear to me to be sufficient reason for introducing them into the already overburdened catalogue of remedies. All needful information in relation to them will be found in the *third part of the U. S. Dispensatory* (12th ed.).

SECTION SECOND.

Diffusible Stimulants.

UNDER this division of General Stimulants are included those which act quickly and energetically, but only for a comparatively short period. In the degree in which they possess the stimulant property they differ much among themselves; but, as a general rule, they greatly exceed, in this respect, the permanent stimulants, embracing the astringents and tonics, which have just been under consideration. One of the laws of all stimulation, whatever may be its degree, is that it is followed by a depression proportionate, at least approximately, to the previous exaltation of the function or functions excited. Hence, the remedies belonging to the present section, as they exceed the astringents and tonics in rapidity and extent of stimulant action, leave behind them a more speedy and greater depression.

General Therapeutic Remarks on Diffusible Stimulation.

The condition to which this therapeutic process is applicable, is obviously that of general depression of the actions or powers of the system. To a considerable extent, the observations made upon tonic stimulation in reference to the possible injury from its abuse, and to the conditions of depression or debility admitting and calling for its employment, are applicable also to this variety, and need not be repeated. Only a few remarks, more particularly bearing on the subject at present under consideration, are required.

As a general rule, the diffusible stimulants may be resorted to in cases of considerable, and especially of rather sudden or acute prostration, which tonics and nutritious food are either too slow in action, or too feeble in stimulant power to counteract. But some cautions are necessary.

Sometimes there is great prostration of the vital actions, depending on the concentration of blood and nervous power in some large organ, or extensive structure in the interior of the body, in a state of high inflammation. This may without caution be mistaken for real debility, and fatally treated under that impression. It occurs usually at or near the commencement of the inflammatory attack, and will in general be readily diagnosticated by the evidences of the existing inflammation, if the practitioner be on his guard. In these cases, bleeding is the great remedy, if it can be employed; the system reacting as the interior organs are unloaded, and the pulse rising under the lancet. But sometimes the least amount of blood lost so far impairs the powers of the heart as still further to depress the pulse. Under such circumstances, stimulation may become necessary in order to excite the heart, and rouse up the circulation generally, so that loss of blood may be borne, until the relief of the internal congestion shall remove the depressing force. But it is obvious that the stimulation must be such as will not be likely to continue into the period of reaction, as it would much aggravate the danger of inflammation. Therefore, reliance should mainly be placed on external stimulation, which can be withdrawn at any moment when desirable; and, if this should prove insufficient, the stimulants of briefest action should be preferred, as heat, the ammoniacal preparations, and those of ether.

Another analogous condition, in which precisely the same cautions should be observed, is that collapse of system which generally attends violent concussion of the brain, and not unfrequently occurs after any severe shock upon the system, as from accidental injury, or a surgical operation. The nervous centres are here prostrated, and all the vital functions fail in consequence. Sometimes reaction never takes place; but when it does, inflammation and fever almost always ensue, and might be greatly aggravated by the previous injudicious use of stimulants. But these are sometimes essential to assure reaction. The external, and those of brief action are here also indicated; and those especially should be avoided which would peculiarly stimulate the organ likely to become the seat of inflammation, as the brain in concussion.

Again, collapse calling loudly for diffusible stimulation sometimes occurs in the cold stage of febrile diseases, particularly those of a typhous and malignant character, and the exanthematous. Here also reaction will take place if the patient survive; and, although equal caution in regard to prolonged stimulation is not necessary as in the former instances, the reaction itself being often tainted with debility, yet injury may be done by a too zealous employment of the measure, and the stimulants of long-continued action, and greatest influence on the brain, should be resorted to only when it becomes obvious that external and brief internal stimulation will not answer.

But when debility occurs in the course of acute disease, as in the various febrile affections, diffusible stimulation may be employed without scruple, and usually in a degree exactly corresponding with the apparent call for it. Here there is no danger of subsequent reaction. The prominent indication is to support the system until the depressing agency shall have ceased, and either the system have recovered its energies, or the disease run its course.

Even the coexistence of inflammation does not, under such circumstances, altogether contraindicate the use of stimulants, though it should dispose to greater watchfulness not to exceed the necessary point. Various inflammations occur in the course of fevers of the low or typhoid character, in which the blood and nervous force are both greatly impaired, and often will not sustain life unless by the aid of the diffusible stimulants. Local measures, even moderate cupping or leeching, fomentations, blisters, etc., and the careful use of the mercurials, may be employed for the inflammation, while stimulants may be freely used to support the functions, and nutritive matter to supply a better blood. This remark, too, is applicable even when the inflammation may have been the original affection, provided the symptoms of typhous debility, and a depraved or poisoned blood supervene. Examples of this kind we have in typhous pneumonia, typhous dysentery, malignant sore-throat, and the prostrate or malignant forms of scarlet fever, smallpox, and erysipelas; and there is scarcely one of the exanthematous fevers, or of the local inflammations to which the remark will not apply.

Another condition of debility, often demanding the free use of the diffusible stimulants, is that which attends acute febrile affection or inflammation occurring in persons previously worn out by enfeebling disease, bad living, or habits of intemperance. In the last case, it is generally necessary, even when the lancet may be employed for the cure of the inflammation, to administer stimulants to support the heart and nervous centres, which would refuse to act without them. This is an important therapeutic principle in the treatment of habitual drunkards, and even of those who have been long in the habit of using ardent spirits in great excess, though never obviously intoxicated.

Again, when the system is exhausted by profuse evacuations, as in the hemorrhages, cholera, diarrhœa, etc., by long-continued disease of almost any kind, or by copious suppuration, the result of antecedent inflammation, or is prostrated under the influence of gangrene from the same or some other cause, diffusible stimulants are often necessary to support life until the system recovers its powers, or the processes referred to shall have terminated, as they usually have a tendency to do, in health. Often, in these cases, tonics and a nutritious diet, or even the latter alone, may be sufficient; but frequently also the diffusible stimulants are essential.

Whenever, moreover, the blood becomes so impaired by an absorbed or otherwise introduced poison, as to be incompetent alone to the support of the vital functions, diffusible stimulants must be freely used, in order to sustain life as long as possible, in the hope that the poison may be thrown off, or that the blood and solid tissues may pass through the series of morbid changes set on foot by the poison, and return to the sound condition. Thus, purulent infection, the state of system resulting from poisoned wounds, as in dissection, and the poisonous condition produced by the bites of serpents and other venomous animals, will sometimes recover under potent stimulation, when the patient might perish without it.

Finally, there are diseases in which the nervous centres appear to be prostrated, without any observable vitiation of the blood, and without at first any considerable failure in the actions of the heart; in which, however, powerful stimulation is sometimes essential. Not to mention delirium tremens, in which this condition of the nervous centres results from the withdrawal of a wonted stimulus, and which often imperiously demands stimulation to save life, there are tetanus, and various other violent spasmodic and nervous affections, among which mania may be sometimes included, in which the same remedial measure is often of great importance.

Division of Diffusible Stimulants.

Most of the general excitant influences, though they may in a greater or less degree affect the whole system, are characterized by having a preferable tendency to some one of the subordinate systems rather than to another; and hence the stimulants belonging to this section are divided into the arterial, the cerebral, and the nervous, according as they exhibit a tendency to excite more especially the circulation, the brain, or the nervous tissue generally. To this rule, however, there is one striking exception. Heat is a vital stimulus essential to the support of every function in its normal state, and capable, therefore, when operating in excess, of producing over-excitement in all parts of the body. It is a universal stimulant, and is capable of being remedially employed as such with very great advantage. The consideration of it as a remedy falls within the scope of this work, and, in relation to its stimulant powers, belongs especially to the present section. Having, however, other therapeutic properties, it will, in reference to these, be treated of in connection with the several classes to which it may belong, as the diaphoretics, rubefacients, epispastics, and escharotics. The following observations apply only to its properties and uses as a diffusible stimulant. Electricity is another diffusible stimulant, which, though employed more especially in reference to its action on the nervous system, is really universal in its influence, and can be brought to bear, as a rapid and powerful excitant, upon any one of the systems or organs of the body. This, therefore, must be considered as belonging to the present division of remedies, and will be treated of after heat.

◆

I. HEAT AS A DIFFUSIBLE STIMULANT.

It is only when of higher degree than the temperature of the body, or of that part of the body to which it may be applied, that heat is used therapeutically. No precise degree, therefore, can be fixed, at which it will take rank among remedies; for the temperature of the body which must determine this point, is itself variable. But, as a general rule, it may be said that a heat of 95° F. or upwards, may be remedial; for this is above the average temperature of the surface of the body; and a decided sensation of heat will be excited by the contact of a conducting substance, at that temperature, with the skin. But, should the surface be very cold, a much lower temperature than that mentioned might prove stimulant; and, on the contrary, should it be very hot, a higher might be applied without any effect of the kind. It will be remembered, therefore, that when precise degrees may be mentioned hereafter, they are to be considered not as fixed, and applicable under all circumstances; but merely as an average, and of course to be varied with the particular condition of the body at any given time. It will be found also, in the progress of these observations, that the mode in which heat is applied influences very much the degree at which it will act as a remedy.

1. *Effects of Heat on the System.*

The first effect of heat is to excite its own peculiar sensation in the seat of application. In a moderate degree, this may not be unpleasing; indeed, when the temperature has been depressed below the normal standard, it is often highly grateful; but, if increased, it begins at length to become painful, and in its higher degrees is often extremely so. The excitant influence is speedily extended to the capillaries, which dilate under the stimulation, admitting a larger amount of blood, and thus reddening the surface, and producing a greater or less distension of the tissue generally. The blood of the part, thus increased in amount, and at the same time flowing more rapidly with the increased action of the vessels, receives an increment of heat from without, which it carries through the system, to produce everywhere a degree of the same stimulant effect first produced upon the surface of application. The impression upon the nerves, moreover, is transmitted to the cerebral and spinal centres, exciting them to increased action. A universal stimulant influence is thus exerted. The heart beats more rapidly and energetically; and the pulse is consequently fuller, stronger, and more frequent. The respiration is hurried. The general temperature, under the universal excitation, is elevated in a degree much greater than would result from the mere addition of caloric from without. The secretions are promoted; all of them probably at first, under a gentle operation of the stimulant; but, when the heat is considerable and continued, the mucous membranes and the kidneys appear to be irritated beyond the point of free secretion, as indicated by a dryish state of the mouth, and diminished discharge of urine; while the secretory functions of the liver and skin are augmented, so that there is usually a freer flow of bile, and greater or less increase of perspiration. An explanation of this difference in effect, and of its uses, will be given hereafter under the head of diaphoretics. At present it is sufficient to observe that, in some instances, even the liver and skin appear to be so much irritated as to be unable to perform their functions, and the patient consequently suffers with hepatic congestion, and general heat and dryness of the surface. Along with the exaltation of the organic functions, the nervous also become excited. A moderate influence of the cause is usually attended with agreeable effects. Sensibility is rendered more acute, muscular motion invigorated, and the intellect, imagination, and feelings more or less exalted. But these functions, under a higher degree of the excitation, become deranged, and at a still higher are impaired; so that a feeling of fulness and even painful distension of the head, vertigo, and other abnormal cerebral sensations, and hebetude of the intellectual and emotional functions, are often experienced. This result is simply in conformity with the general law, that, by moderate over-excitation or irritation, the functions are increased in a normal direction, by a greater amount of it, are deranged, and by a still greater, are diminished or suppressed. The generative functions obey the same general law; and the sexual feelings are excited, the menstrual act promoted, and the capacity for conception probably increased, under the genial influence of a moderately elevated temperature; while they may be perverted or suppressed by its excess. Should the heat be very considerable, or continued too long, a universal acute derangement of the functions may take place, constituting fever; and this is the condition of system existing in the disease called *sun-stroke*, and for which the name of *heat-fever* has been proposed, under this idea of its nature.*

As in the case of almost every other stimulant, the excitement produced by heat in the functions, is followed by a proportionate depression. The excitability, exhausted by excessive exercise, now fails to respond to the ordinary vital stimuli, and action is of course diminished. As before stated, this may be considered as a nearly universal law of stimulation. Hence the soft, compressible, and often feeble pulse, the cool, pale, and relaxed skin, the muscular debility, the lassitude or indisposition to exertion, the mental languor, and the tendency to sleep, after the subsidence of the general excitement produced by the hot bath. Hence, too, the enfeebled state of system, the habitual languor and lassitude, experienced after a prolonged exposure to the heats of summer, or a residence of some months in a tropical climate.

---

* See the article on *Heat-fever* in the sixth edition of my Treatise on the Practice of Medicine. (*Note to the third edition.*)

2. *General Therapeutic Application.*

Two main purposes are fulfilled by heat acting as a stimulant; *first*, to elevate the depressed, or support the failing functions; and *secondly*, to equalize the distribution of the blood and nervous energy, by attracting them away from parts where they may exist in excess towards the seat of its own immediate action. These two indications not unfrequently exist in the same case, and are fulfilled by the same application of the remedy; as in those instances of great prostration, with concentration of the blood in the interior, which are presented in the initial or cold stage of malignant fevers. Here the stimulant influence of heat, applied to the surface, rouses the prostrated nervous centres and the heart, while it calls forth the accumulated blood from within, and unloads the oppressed vital organs. Frequently also the two purposes are separately fulfilled; as when heat is applied, in one instance, to aid internal stimulants in supporting the sinking system in the advanced stage of febrile diseases, and, in another, to draw excitement away from the brain or lungs, towards the lower extremities in threatened apoplexy or pulmonary congestion. But it will be most convenient to treat of the special uses of the remedy, in connection with the several modes of applying it, which are next to be considered.

3. *Modes of Applying Heat Therapeutically.*

Of the heat generated within the body by exercise, stimulation, rich diet, friction, etc., I shall not here treat, because it is a result of other measures, and, though it may be one of the means by which those measures prove remedial, it cannot be itself considered in the light of a remedy.

There are two modes of obtaining the direct influence of heat; *first*, by preventing the escape of the natural heat of the body, and thus causing its accumulation, and *secondly*, by imparting it to the body from other heated substances.

1. *Confining the Heat of the Body.* This is effected by surrounding the person with a badly conducting medium in the form of clothing, or bed-covering at night, or in that of a dry atmosphere, which is a very slow conductor.

a. *Clothing.* Much may be done in the management of morbid tendencies, and even of disease itself, by a proper regulation of the clothing.

Furs, feathers or down, and wool are the worst conductors of heat; tissues made of raw silk are, perhaps, next in order; then tissues of cotton, and after this linen, which is the most rapid conductor of all the materials used for clothing. It is obvious that, when the object is to keep the surface warm, a selection should be made from these substances, whether for body clothing, for bedding and bed-covering at night, or for occasional use under extraordinary exposures to cold, according to the degree of protection wanted; the worst conductors being chosen when it is most important to confine the animal heat. Upon the whole, the most suitable under-clothing for keeping up an equable temperature of the body is flannel, or the elastic woollen tissue now so much worn, which has the advantage over flannel that it shrinks less by washing, and is not apt to become so hard and stiff. When it is specially important to preserve an equable temperature, this should be worn through the whole year, summer as well as winter; the quality being accommodated to the degree of heat. The fabric may be had of every diversity of texture, from the coarseness of the heaviest flannel, to the fineness almost of gossamer; and the lightest should be chosen for summer wear. It is scarcely less important in the warm than the cold season; for the changes of summer are very great, and the surface is even more susceptible to cold than in winter, in consequence of its frequent relaxation under a high temperature. Should even the lightest woollen fabric be insupportable in the most intense heat of the season, a similar tissue made of raw silk may be substituted, or, if this cannot be had, of cotton; but, in cases of delicate health, where the preservation of the temperature is important, linen should never be worn next the surface of the body, unless when the skin is excessively irritable; and, in that case, wool, silk, or cotton should be worn over it. Persons in whom this kind of caution is essential, should be peculiarly careful to keep the feet warm and dry, either by woollen stockings, or, what is sometimes preferable, double stockings, one pair of silk, and the other of cotton. Occasionally, woollen hose keep the feet in a constant perspiration, which moistens the covering, and serves to convey away the heat; so that these parts are always cold. This evil may often be corrected by wearing the double hose just referred to. In wet weather, the boots or shoes should always be water-tight, when the person is exposed out of doors; but they should be exchanged for others within doors, as they confine the perspiration, and cause the feet to be cold by making them damp. The outer covering should always be proportioned to the degree of cold, when the body is necessarily exposed to it. Some delicate individuals think they can harden themselves against cold, by habitual exposure; and hence encounter the severest weather with insufficient covering. This is a great mistake. They frequently, I believe, expose themselves in this way to the great danger of aggravating a morbid diathesis into positive disease. The proper rule is never to allow one's self to become chilled for any length of time. An excellent mode of preventing the evil results of the present fashion of open dressing over the chest, is to suspend from the neck, under the shirt, a piece of doubled silk with cotton wadding quilted within, or a dressed rabbit's skin. At night, equal attention is necessary to preserve a due degree of warmth. The covering should be sufficient to render the person comfortable; and, with delicate persons, it is better to err on the side of excess of warmth than that of cold. The habit of using mattresses in summer is very well; but feather beds should be employed, in winter, by all persons in whom the indication for sustaining a warm temperature of the body exists. I think I have known the most serious evils result from an attempt, on the part of individuals of scrofulous predisposition, to harden themselves to the influence of cold; and carelessness on this point may be equally injurious. It will be observed that I am not applying these remarks to the healthy and robust. For these, equal caution is not necessary; though even they would do well to exercise some care in the point under consideration.

The predispositions and affections to which these observations are especially applicable are those of a scrofulous or tuberculous character. A continued depression of temperature beneath that of full health is peculiarly injurious in all the forms of tuberculosis, whether before or after the deposition, and in all cases of a strumous character or tendency. Hence the advantage, on the part of such individuals, of a residence in warm climates; but, when this is impossible, much can be done by a due attention to clothing, by day and by night, and at all seasons. I do not say that temporary exposures to cold may not sometimes be useful in these persons, through the tonic influence of the reaction. But such exposures should always be purposed, not accidental; should be employed in a remedial capacity, and not left to the caprices of chance; and, when they are resorted to, the utmost care should be taken that due reaction shall ensue. When this takes place with difficulty, they should be at once abandoned. The above remarks may seem trivial to the inexperienced; but those who have seen much of disease know, that influences of the kind here alluded to are quite as important as medicines, and will agree with me in the necessity of attention to them.

But it is not in the scrofulous cachexia only that a due preservation of warmth is important. All low forms of disease, and especially the low fevers, are promoted by constant chilliness; and no fact is more universally admitted in medicine, than that change of temperature, and especially exposure to cold after heat, is one of the most fruitful causes of the various inflammations. The preservation of a moderate warmth of surface, not sufficient to induce perspiration, is one of the great hygienic rules which should be attended to under all circumstances.

b. *Dry Air.* Another method of sustaining the warmth of the body is to surround it with dry air, which is a very bad conductor. But dry air favours greatly the evaporation of liquids, and thus tends to act injuriously, in many instances, on the mucous membrane of the air-passages, and on the skin. It is, therefore, only under peculiar circumstances that it can be resorted to remedially. It is indicated in patients of a debilitated habit, with a disposition to excessive moisture of the surface, and excessive bronchial secretion from chronic disease of the air-passages. In certain cases of pituitous catarrh, or humoral asthma as it was formerly called, with a cool perspiratory state of the surface, confinement to such air may prove useful. This is readily accomplished, in winter, by warming the external cold dry air by passing it over heated surfaces, without supplying water to moisten it, in its passage into the chamber. Great facility for this purpose is afforded by the present plan of heating houses from furnaces in the cellar.

2. *Imparting Heat to the Body.* The methods of accomplishing this object are numerous, and each requires a special notice. They may all be included in two divisions; the first embracing those in which the heating body used is *dry*, the second those in which it is *moist*. There is an important difference between these two methods. By the first we obtain the effects of heat alone; in the second, the sedative influence of moisture, and the conducting power of water, modify these effects often very materially. These influences will be considered when we come to the methods of applying moist heat.

a. *Dry Heat.* This is imparted either by radiation, or by the direct contact of the heated medium.

Insolation, or exposure to the rays of the sun, is the most effective mode of obtaining the influence of *radiant* heat. It is sometimes agreeably stimulant to the old, feeble, and paralytic, and appears to act as a restorative in the debility of convalescence. As the combination of heat and light, in the direct rays of the sun, is essential to the perfect development of vegetables, so is it probably also to that of animals; and there is little doubt that this is one of the influences which, combined together in a journey through the country in the warmer seasons, tend so powerfully to build up a system dilapidated by disease, worn out by over-exertion, or languishing from the confinement, impure air, and in-door dwelling of a town life. To the scrofulous and consumptive, exercise in the pure sunny air is peculiarly beneficial; and the direct warmth of the sun, by a positive stimulation and invigoration of all the vital processes, contributes considerably, I have little doubt, to the favourable influence of a residence in warm climates over a tuberculous diathesis. An excess of it may, of course, be injurious, and must be guarded against, especially its immediate action on the brain.

The *radiant heat of a fire* may be used as a substitute for insolation in the old and feeble, during winter. The same mode of heating is often used for equalizing the temperature in cases of cold hands and feet; and, in attacks of spasmodic colic, or of subacute and neuralgic rheumatism from exposure to cold, a thorough heating of the feet, before a good fire, will sometimes produce a cure.*

Substances used to impart dry heat to the body by *conduction* are solid or aëriform.

Of the former class are *bottles* filled with hot water or heated sand; *tin vessels* made to fit certain parts of the body, and filled in the same manner; *metallic bodies*, such as flat-irons heated; *hot bricks; bags* filled with heated *oats*, *sand*, or *ashes*, and shaped so as to lie conveniently along various parts of the body; and towels heated as hot as the skin will bear them, and applied folded to the surface. These means may be had recourse to in the cold stage of febrile diseases; the advanced stage of the same diseases, with general feebleness and coldness of the extremities; the collapse of cholera and other bowel affections; asphyxia, complete or partial; the external paleness and chilliness attendant on severe colic, and violent spasms of the stomach, gall-duct, and ureters; in short, whenever there is an indication for the general stimulation of heat, or its derivative influence from irritated, congested, or inflamed organs. In cases of great emergency, when some powerful impression may be necessary to rouse the failing sensibilities of the system, a *red-hot coal* may be applied to the surface, especially to the epigastrium. I have known of an instance of this kind in malignant typhus, in which the patient, who had sunk below the reach of all ordinary stimulants, was roused by this means, and, on recovering afterwards, said that the sensation of the burning coal had been positively agreeable to him, in the state of horrible vacancy of feeling to which he had been reduced. When the solid bodies above enumerated are brought into contact with the surface, care must be taken that they are not hot enough to burn the skin; and this caution is the more necessary, because the patient is often himself too insensible at the time to give notice of the danger. It is sometimes advisable to wrap them in flannel, in order to interpose a slow conductor between them and the skin.

---

* A very interesting case of resuscitation, in a new-born infant, under the influence of heat, is recorded by Dr Jos. G. Richardson, of Cayuga Co., New York, in the *American Journal of Medical Sciences* (January, 1867, p. 128). Induced by the success of Dr. Richardson, of London, in restoring the action of the heart by injecting heated blood into the coronary arteries, he conceived the idea of imitating the experiment on the living body; and, in the case of the infant referred to, finding all other methods, including artificial respiration, but partially successful, he caused the lower extremities of the child to be heated before a fire as highly as could be borne without producing local mischief, and then by pressing the heated blood in the veins of the limbs towards the heart, he endeavoured to introduce it in that state into the coronary vessels. The effect, he states, was "almost miraculous." The heart, which had before acted feebly and involuntarily, quickly began to pulsate energetically, the respiration became continuous, and the prospect of a thorough restoration was very encouraging; but subsequently, in the absence of the physician, death occurred from the officiousness of the nurse in giving nourishment, contrary to the injunction of the physician to avoid it. (*Note to the third edition.*)

Heated air may be employed for the same purposes. The body will support a much higher temperature of the surrounding air when it is dry, than when moist, because in the former state it is a much worse conductor. Persons have even remained, for a short time, in chambers heated considerably above the boiling point, without suffering material inconvenience. According to MM. Berger and Delaroche, when the temperature is between 150° and 190°, a smarting sensation is produced in the surface, particularly in the conjunctiva and nostrils, the veins swell, the skin becomes burning hot, the pulse is very greatly accelerated, even to 160 in a minute, the respiration is laboured, and vertigo, headache, and other disordered cerebral phenomena are experienced; but very soon a copious perspiration breaks out, and tends in a considerable degree to obviate the unpleasant effects. (Forbes, *Cyclop. of Pract. Med.*, Am. ed., i. 286.) It is very seldom necessary, however, in order to obtain any desirable stimulant effect, that the temperature should exceed 150°; and often a much lower heat will answer. The stimulation is greatest when the patient is wholly immersed in the hot air, so as to inhale it into the lungs; but it is a safer and equally effectual plan, for all practical purposes, to allow the hot air to be applied only to the surface of the body, while the patient breathes air of the ordinary temperature. As, in many of the cases to which the remedy is applicable, there is an indication for revulsion from the interior to the surface, the latter plan is preferable on this account. For the modes of preparing the hot-air bath, see *page* 70, in the first part of this work.

The hot-air bath is probably more frequently used with a view to produce perspiration than as a mere stimulant. For the latter purpose, however, it may be resorted to with much benefit in certain cases of prostration, with coldness of the surface, to which more particular reference will be made when the therapeutic applications of the hot-water bath are considered. As this cannot always be commanded, the hot-air bath, which can generally be quickly prepared and applied with facility, may often be substituted for it with advantage.*

---

* Through the efforts of Mr. Urquhart and others, the use of the hot-air bath has recently received great extension in England, with extraordinary therapeutic results. Of the various public and private baths, erected within the last seven or eight years, one connected with the Newcastle Infirmary, under the supervision of Sir John Fife, has yielded a large experience of this mode of cure, which, in the course of five years, has been employed in more than 20,000 cases. The complaints

b. *Moist Heat.* In moist heat, two quite distinct agents are combined, which must be considered separately before their joint influence can be well understood. Heat is purely stimulant; water, purely sedative; and the result of their combined action will depend on the proportion in which they respectively exist in the combination. The influence, too, of cold, that is, of the diminution of heat below the normal standard of the surface of our bodies, must be taken into account. This is sedative; but differs in this respect from the sedative influence of water, that its depressing effect is always attended with a disposition to reaction, which is wanting in the operation of the latter. The sedative properties of cold and water will be more fully considered in a more appropriate place. They are here alluded to, merely to make more intelligible the properties and effects of heat and moisture combined. Water may be applied to the body, with a view to remedial action, at three different temperatures; below, at, and above that of the surface in health; so as to produce, in the first instance, the sensation of cold; in the second, no sensation either of cold or heat; and in the third, that of heat. It is obvious that, by a bath answering to the first condition, the joint depressing influence of cold and of water would be produced; to the second, the purely sedative influence of water; and to the third, the combined sedative influence of water, and stimulant influence of heat. The first two conditions of the bath may be left out of view in this place, as not belonging to the subject of stimulation. It is to the third only that our attention is to be now directed; that, namely, in which the temperature of the bath is above that of the surface, so as to occasion the sensation of heat.

Hot Bath. In a bath of this kind, the effects are both stimulant and sedative; and whether one effect or the other shall predominate, must depend on the degree of the temperature above that of the surface of the body. When the elevation is but moderate, the two influences may balance each other; so that neither elevation nor depression of the vital functions shall be perceptible; and this is the condition in which the bath can be longest borne, and which should be aimed at when the mere cleansing effect of water, with as little impression as possible of any kind upon the system, is required. But this equation of effect is obtained only after a short period of immersion. Heat acts more quickly than

---

in which satisfactory results are said to have been obtained from it, are, among others, acute and chronic rheumatism, gout, neuralgia, catarrh, various throat affections, diarrhœa, dysentery, diseases of the liver and stomach, dropsy, scrofulous affections, and incipient phthisis. It is not, however, as a general stimulant exclusively that it operates in such cases. Its strong revulsive influence must greatly contribute to its efficiency; and, as a powerful means of producing diaphoresis, it acts both as an evacuant, and as an eliminative agent with great effect. In reference to these effects of the hot-air bath, it will be more particularly noticed hereafter. (*Note to the third edition.*)

water; and its excitant influence, even when it is only in very moderate excess, is experienced before the water has fairly begun to operate; so that a short time must elapse before the balance is established. Nor does the exact balance continue long. Under the stimulus of heat, the excitability is impaired, and the excitation consequently gradually ceases, and is at length followed by depression, according to the general law; while the sedative effect of the water is increased, the longer that agent continues to operate. Hence, the short period during which the two are balanced is followed by a period of depression much greater than the antecedent elevation, and increasing with the continuance of the agent. The bath, therefore, of which the temperature is but slightly above that of the surface, can scarcely be considered as a stimulant agent; the excitant effects being moderate and very brief, and the sedation soon predominating. It is, therefore, as a sedative remedy that it is almost uniformly employed; and as such it will be considered hereafter, under the name of the *warm bath*. The title of *hot bath* should be confined to that in which the heat is felt at first rather disagreeably, and in which the excitant effect decidedly predominates, and continues to predominate for a considerable time. It is the operation of this variety of the bath that is now to be considered.

The limits of the hot bath, as determined by the sensations, may be placed, in reference to the lower extreme, at the point when the heat is merely somewhat uncomfortable; in reference to the higher, at that in which it is barely not insupportable. As indicated by thermometrical degrees, they cannot be fixed precisely; because they vary with the variable sensibility and temperature of the surface; but the lowest point may be considered as somewhere between 95° and 100° Fahr., and the highest between 106° and 112°; and it is never advisable to exceed the degree last mentioned. At the mean of 103°, the bath is actively stimulant, producing a strong sensation of heat, reddening and expanding the surface of the body, increasing the frequency, force, and fulness of the pulse, hurrying the respiration, and causing at first an agreeable excitement of the brain, not unlike the effect produced by wine, but ending, if the immersion continue, in painful sensations of fulness, distension, and vertigo. After a time, perspiration breaks out upon those parts of the body not covered with the water; and, if the patient is removed from the bath, and placed in bed, the whole surface usually becomes relaxed, and bathed in a copious sweat. The excitement gradually subsides; and is followed, if the regular succession of events is not modified through some abnormal state of the system, by universal relaxation, with depression of the pulse, muscular weakness, feelings of languor and drowsiness, and ultimately sleep. The immersion may continue from four or five minutes to half an hour, according to the effects; the patient being always removed when unpleasant cerebral phenomena are produced, and never allowed to remain when the stimulant effect is the main indication, until evidences of depression supervene.

The operation of the water in the hot bath is at first, through its conducting power, to hasten the stimulating effects of the heat, but afterwards, by the relaxation it produces, to favour the secondary depression; and the latter result often adds greatly to the beneficial influence of the remedy, when it is designed to act rather as a revulsive agent than as a general excitant.

The conditions indicating the use of the hot bath are 1. coldness of the surface, with either general prostration, or powerful and concentrated internal irritation, inflammation, or congestion; and 2. an abnormal state of system, in which a strong impression is required, to break up long-continued and obstinate morbid associations. The following are affections in which these indications are presented.

In the *cold stage of febrile diseases*, particularly those of a malignant or pernicious character, there is sometimes a degree of prostration and indisposition or inability to react, which is extremely dangerous. The nervous centres seem to have become almost inert under the violence of the morbid cause, and the most important vital functions are prostrate under the want of their necessary influence. The heart acts feebly, the surface is cold and pale, and the great internal organs are loaded with the venous blood which accumulates in them because the moving forces are unable to carry it forward. Sometimes death takes place without any reaction; sometimes feeble and insufficient efforts at reaction are made, and the patient sinks back into the same alarming prostration as at first. In aid of other stimulant measures, the hot bath may often be resorted to, in these cases, with great advantage. Through its powerful impression on the surface, it rouses the nervous centres from their torpor, and thus indirectly excites the circulatory and respiratory functions; by heating the blood as it passes through the vessels of the skin, it renders that fluid more stimulating to the great interior organs, as the heart, lungs, and brain, into which it is conveyed; and, while thus acting as a powerful general stimulant, it is no less powerfully revulsive, irritating the whole of the cutaneous capillaries to an active expansion, and drawing into them the blood before accumulated in the central viscera and great venous trunks. It is one of the most efficient agents in such cases, in bringing about reaction. Typhus fever, pernicious miasmatic fever, smallpox, scarlatina, and epidemic erysipelas are among the diseases, in the initial or cold stage of which the hot bath not unfrequently proves useful on the principles here stated. It has, too, the great advantage over internal stimulants, that it can be at once withdrawn when needed no longer, and does not add, by a prolonged influence, to the violence of the reaction when this is brought about.

In *sudden prostration occurring in the advanced stages of low fevers*, in *prolonged asphyxia*, in the *collapse of cholera, hæmatemesis*, and *melæna*, similar indications are afforded by the cold surface, the prostrated vital functions, and the interior congestion.

In the *retrocession of cutaneous eruptions*, the hot bath is often useful. In some instances, the apparent retrocession is nothing more than a sudden general prostration, in which the actions of the surface fail with those of the whole system, and which differs in nothing from the sinking spells of low fevers noticed in the last paragraph; but, in most cases, it is owing to, or connected with the occurrence of severe internal irritation, which it is highly desirable to recall as quickly as possible to the surface. Not unfrequently, a similar condition existing previously to the eruption, retards its appearance, and sometimes it may even keep back the cutaneous affection altogether, to the great detriment of the patient. Under these circumstances, the hot bath proves serviceable by powerfully exciting the skin, and making this the seat of afflux for the irritative tendencies. The eruption again appears, or comes forth if not previously existing, and the symptoms of internal disorder cease almost instantaneously.

Painful internal spasms are generally more beneficially treated by the relaxing warm bath than by the stimulant hot bath; but sometimes they are so severe, and attended with so much general prostration, that the former remedy is quite inefficient, and it becomes desirable to have recourse to the greater energy of the latter. Violent *attacks of nervous gout in the stomach and bowels*, of *colic*, and of *spasm of the diaphragm*, are examples of this kind. The remedy acts by a revulsive impression on the general surface.

Internal inflammation is usually not a proper subject for the influence of the hot bath, which too much excites the circulation, and sends the blood too forcibly into the parts affected; but, in certain cases, the inflammation is so violent and extensive as to concentrate the blood and the nervous energy of the system in its own seat, with the effect of prostrating the general functions, and inducing great apparent debility, for which, indeed, the condition has sometimes been fatally mistaken. The cold and pale surface, and feeble pulse seem to call for active stimulation; while, in fact, prompt and free bleeding is indicated, and is sometimes the only remedy which will save the patient. Generally, under these circumstances, if a vein is opened, the blood will flow, slowly and scantily at first, but with a gradually increasing current; and, so far from still further failing, the pulse will rise, and become fuller and stronger, as the operation proceeds. This, however, is not always the case; and it is found impossible to continue the bleeding without endangering fatal prostration. In such a case, the hot bath is an admirable remedy. By its powerful revulsive action it calls the blood from the interior to the surface, stimulating the heart at the same time; and though of itself it would be altogether inadequate to the cure, and, if continued, might act injuriously upon the inflamed organ by sending the blood into it too vigorously, yet it prepares the system for the use of the lancet, and thus opens the way for a cure which might not otherwise be possible. It should of course be withdrawn the moment that it has answered its purpose. In cases of this kind, the warm bath, though useful in ordinary internal inflammations, would be quite inert; and might even be injurious by its sedative action on the surface and the heart. Extensive inflammation of the peritoneum, dysentery of extraordinary intensity, and violent pneumonia in the congestive stage, and occupying both lungs, sometimes present the condition referred to.

Obstinate *chronic enteritis*, with little or no excitement of the circulation, and an habitually dry, palish, and cool skin, may also be advantageously treated with the hot bath, repeated every day, especially if made somewhat more permanently irritant to the skin by the addition of common salt; and the same remark will apply to inflammation of other abdominal viscera, presenting the same conditions. In the first mentioned affection, I have found the hot salt-bath one of the most efficacious remedies.

It was stated above that the hot bath is indicated in some obstinate long-continued affections, in which it appears to act by breaking up morbid associations. Possibly it may operate by a penetrating stimulation of all the tissues, which are thus roused out of their habit of morbid action into an over-excitement, from which they may afterwards subside into health. In some such method as this, it sometimes proves beneficial in cases of *chronic rheumatism* and *gout*, occupying at the same time various parts of the system, distorting the joints, contracting the tendons, and not unfrequently, to a greater or less extent, paralyzing the muscles. It is not impossible, however, that the diaphoretic action of the bath may add to its efficiency. The bathing at hot springs has proved peculiarly useful in these diseases.

Perhaps in the same category may be placed certain *chronic and indolent affections of the skin*, in which the tissue requires to be roused alike out of its torpor, and out of its morbid habit of acting. Caution is necessary not to use the bath at too early a stage; and if, as often happens with stimulating applications made prematurely, it should be found to excite inflammation or high irritation, it should be immediately suspended. It should also be accompanied with alterative measures, to change the constitutional condition, while the attempt is made to relieve the local disease.

In paralytic cases of long standing, in which the original cause, if affecting the nervous centres, has quite ceased to operate, and the disease is sustained by a morbid indolence of the tissues concerned, whether nervous or muscular, some good may be hoped for from the hot bath, in connection with other measures.

The *contraindications* to the use of the hot bath are a plethoric state of system, determination of blood to the head, active hemorrhagic tendencies, general vascular irritation with active congestion, aneurisms and hypertrophy of the heart, acute inflammation with well-developed fever, the febrile state generally with a hot skin, and a peculiarly irritable state of the nervous system.

Local Hot Bathing. Hot water may be employed locally by *semicupium, coxæluvium, pediluvium, maniluvium, fomentation,* or *cataplasm.* For an account of these methods of application, the reader is referred to *page* 69. They act on the same principles as the general hot bath, but are much less powerful, and, with the exception of the *semicupium,* or *half-bath,* which is usually employed as a milder substitute for the general bath, and in cases where determination to the head or trunk is feared, are used less for general stimulation, than for their excitant effect on some one part or organ of the body, or for their revulsive influence.

Thus, the *hot hip-bath* is used to stimulate the uterus in amenorrhœa; and the *hot foot-bath* and *hand-bath* to act revulsively from the head or interior organs towards the extremities, whenever the latter are cold, and evidences exist in the former of active congestion without fever, and especially when gout or rheumatism has retroceded from the extremities, and it is desirable to restore it to its original seat. *Hot fomentations,* or *hot cataplasms,* are employed to relieve by revulsion either inflammation, spasm, or other irritation of interior organs over which they may be applied, or to stimulate the part to increased action, as when it is desirable to hasten a languid external inflammation onward to suppuration, and through this to a more speedy cure.

Another form of local application is the *hot douche,* or stream of water falling from a height, or directed with some force upon the part. This unites the effects of shock and pressure to the stimulant action of the heat, and proves sometimes more efficient than the simple application of hot water, in chronic rheumatic and gouty swellings, obstinate local palsies, and indolent tumefactions and indurations of inflammatory origin.

Hot Vapour Bath. In some countries there are public vapour baths, in which numbers may be collected in the same chamber; and this is occasionally so arranged, with seats rising one above another, that persons may be exposed to various temperatures; the heat of the apartment increasing from below upward, because it is the tendency of the vapour to ascend. Thus, upon the level of the floor the heat may be only 110° Fahr., while in the uppermost part of the chamber it may be as high as 160° or 180°. Of course, the patient inhales the hot moistened air, as well as feels its effects upon the surface. The vapour may be introduced into the chamber from without, or by throwing water, within, upon stones heated to redness by a furnace beneath. But, in this country, it is only the solitary vapour bath which is employed. For the various modes of preparing it, see *page* 71, in the first part of this work. It may be so arranged that the patient can breathe, at his pleasure, either the moistened air of the bath, or the cold external air. The heating effect of the former is greater; but its revulsive influence is less; and, as it has a tendency to suppress the pulmonary exhalation, it may sometimes act injuriously when the latter would be quite safe.

In consequence of the less conducting power of vapour than of water, the former can be borne at a much higher temperature than the latter; while, for a corresponding reason, the vapour bath may be intolerable at a temperature at which dry air could be borne without inconvenience, the latter being a slower conductor. According to Dr. Forbes, the heating effect of the hot bath, at from 98° to 106°, is equal to that of the vapour bath, when the air is breathed, at from 110° to 130°, and when it is not breathed, at from 120° to 160° (*Cyc. of Pract. Med.*, Am. ed., i. 255); and these are the temperatures within which the methods respectively may be employed; though, in each, the heat may be raised with impunity considerably above the highest point mentioned. The effects of the vapour bath, and of the hot bath, are essentially the same in reference to stimulation and revulsion; but the former is attended with much more copious perspiration during its continuance than the latter; the contact of water with the surface having great effect in preventing extravasation from the blood. Another difference is that the relaxing or sedative effect of the vapour is less than that of the water; and that consequently the stimulation of the former, though more slowly induced, is longer sustained, and is accompanied with a less degree of soothing influence. The vapour bath may be used for the same purposes as the hot bath, but is, upon the whole, less efficient and less agreeable. In its extemporaneous form, it may be employed when circumstances may render it impossible, or extremely inconvenient to prepare and apply the bath of heated water. It is also preferable, in some instances, when the indication is to produce profuse perspiration with a stimulant effect, as in certain cases of chronic rheumatism.

Local vapour baths may be applied by exposing any part of the body to the steam escaping from boiling water, which may be readily confined by a suitable arrangement of woollen or other cloths. But th
employed more for the relief afforded to inflammatory, and othe
affections, by the copious perspiration they induce in the part
stimulant agents.

The same may be said of the *hot vapour douche*, which co
jet of heated vapour directed on some part of the surfa
the simple application of steam only in exposin

portions of vapour, instead of continuously to the same; and the effect is consequently somewhat greater. It may be applied by causing steam to pass through a pipe from a vessel of boiling water; or, in relation to the meatus auditorius of the ear, by holding the orifice of the meatus over the small end of a funnel, the larger end of which is placed over a vessel of water boiling hot. In the latter case, the remedy may be used, as a stimulant to the ear, in cases of defective hearing from deficiency of nervous power.

Finally, *heated vapour* may be applied exclusively to the lungs by inhalation, and thus made to act as a stimulant to the bronchial tubes when enfeebled, and exposed to the excessive production of mucus in consequence of this relaxed state; but the measure would require to be conducted with much caution. At a lower temperature, so as to produce, not the stimulant effects of heat, but the soothing and emollient effects of mere moisture, it may often be used with benefit. But this action of the remedy belongs to another section. For the modes of applying vapour by inhalation, see *page* 75.

Hot Water as Drink. Hot water has the same stimulant effect, when taken internally, as when applied to the surface; but it is almost never used except as a vehicle for other substances, the action of which it often very much promotes, and, even in this mode of administration, is much less employed with a view to its stimulant action, than as a diaphoretic. In cases of great prostration, it may sometimes be advisable to exhibit stimulant drinks heated rather than cool, as their effects are thus both hastened and augmented.

II. ELECTRICITY AS A DIFFUSIBLE STIMULANT.

In treating of electricity as a remedial agent, I shall take it for granted that the reader is already acquainted with its chemical and physical properties, and with the prevalent opinions of its nature. In this place it is to be considered only in relation to its physiological and therapeutical effects, and to the methods of employing it as a remedy. As these effects are materially modified by the modes in which it is developed or excited, and applied, the latter division of the subject must be first treated of, in order that what may be said on the former may be understood.

I wish here to express my indebtedness for much which follows to the excellent work of *M. Duchenne de Boulogne,* who, by his thorough and laborious experimental investigation of electricity in its medical relations, the sagacity with which he has traced the various ramifications of its influence, and the ingenuity and perseverance with which he has applied the knowledge thus obtained to successful therapeutic results, has given a precision to the subject which it before much wanted, and has opened a new era in the history of the remedy.

1. *Modes of Development or Excitation.*

For medical purposes electricity is developed or excited in four somewhat distinct methods: 1. by *friction*, in the form of common electricity; 2. by *contact and chemical reaction*, in the form of galvanism; 3. by *magnetic induction*, in the form of electro-magnetism; and 4. by *a combination of magnetic and galvanic induction*, as by the volta-electric apparatus.

a. *Excitation by Friction.*

General Observations. Electricity excited by friction is usually denominated *static*, conveying the idea that it is stationary or not in action, while in the form of galvanism it is said to be *dynamic*, as being essentially in movement, and exercising power. Though this distinction is not very precise, it may serve at least the purposes of nomenclature. A very great difference exists between the phenomena exhibited by these two forms of electricity; the *static* having in a high degree the properties of attraction and repulsion, and, when brought into movement, exercising great mechanical power; the *dynamic* exhibiting its energy more in developing heat, and producing chemical change. It is supposed that this difference depends, not on any essential diversity of character, but on the different states of the electricity developed in the two methods; that excited by friction having little quantity, but great tension or intensity, by which it is able to overcome resistance, while that set in movement by contact and chemical reaction has feeble tension, but *large quantity*. These terms, however, are rather conventional, intended to represent certain qualities in convenient language, than absolutely expressive of the fact; for it is by no means universally admitted that electricity is a distinct substance, to which the term quantity is at all applicable, unless as a figure of speech.

Means of Excitation. Static electricity is developed by means of friction between two substances, and this is usually effected by an apparatus called the *electrical machine*, constructed in different methods, for an account of which I must refer to works on chemistry or natural philosophy. To every machine is attached an insulated conducting body called the prime conductor, which receives upon its surface the electricity as it is excited, and retains it for a considerable time, in consequence of the non-conducting property of the dry air around it. Thus developed, the electricity acquires a degree of tension, proportionate to the power and working of the apparatus, by which it is enabled to break its way through the resisting air to neighbouring bodies, producing a stream of light in its passage, and a very perceptible sound. When the tension is very great, the spark, as this flash is called, may be many inches long; when very slight, it may be even less than an inch. In order that the electricity may escape in this way, the body approaching the conductor must be rounded or flat; as, if pointed, it receives the electricity quietly, and almost insensibly from the conductor.

Silent Conduction. If any part of the person be brought into contact with the prime conductor, the electricity passes silently into and through it, or along its surface, into the earth, in search of the equilibrium to which it always tends.

Sparks. If, instead of coming into absolute contact with the excited prime conductor, a part of the body be made to approach it within a certain distance, greater or less according to the degree of electric tension, the fluid passes to the body by sparks, which produce a decided sensation as they are received. By means of rods or chains of metal, or other conducting substance, in contact at one end with the prime conductor, and having a rounded knob at the other, the electricity may be conveyed to any convenient distance from the machine, and applied by sparks to any part of the body. These communicating instruments are called directors, and must be insulated from the hand of the operator by some non-conducting substance, such as glass, which may at the same time serve as a handle.

Electrical Bath. Another method of applying static electricity is by placing the patient upon a stool, insulated by glass legs, and then connecting him with the prime conductor. His body thus shares the electricity with the conductor, and acquires precisely the same relations towards the machine and other surrounding objects. In this way it may become saturated with the fluid, which escapes very slowly and silently from the hairs, finger and toe nails, and the surface of the body generally; the hairs rising up and standing apart under its repellent force. Sparks may now be drawn from any part of the body by the approach of a blunt conducting substance; and, by keeping the machine constantly in action, this condition may be indefinitely prolonged. By communicating with the negatively excited, instead of the positive prime conductor, it is obvious that the body may itself become negatively excited; and, by varying the connection, the peculiar effects of either of these two modes of the electric influence may be separately obtained. This method of applying electricity is denominated the electric bath.

Electric Aura. This is a current of electricity directed to any part of the body, through the air, by means of a pointed insulated director, connected at one end with the excited prime conductor by a chain, and, at the other and pointed extremity, held near, but not in contact with the portion of surface to be acted on. The electricity silently and invisibly issues from the point, and, expanding cone-like as it passes through the air, spreads itself out broadly upon the surface. Exactly the reverse takes place, when a similar point is held near the body, itself in a state of electric excitation upon an insulated stool. Little if any sensation is in either case experienced.

Leyden Jar and Electric Battery. By these instruments the greatest force of the electricity of friction is obtained. The jar is a broad-mouthed glass bottle, coated within and without by tin-foil, excepting the upper part of both surfaces, where it is bare. With the inner coating is in contact a chain, connected with a metallic rod, which passes upward through a cork, or other material closing the mouth of the bottle, and ends in a round metallic ball at top. When this ball is put in communication with the excited prime conductor of the machine, the inner coating becomes positively charged while, at the same time, by the laws of electric induction, the outer coating passes into the negative or opposite state. If now a conducting substance be connected with the inner coat by means of the knob, and directly or indirectly with the outer, the equilibrium is instantly restored, and the whole force of the movement is exerted upon the connecting material. If this be the body, a shock is felt, proportionate in degree to the extent of the coated surfaces, and the amount of the charge. It may be so slight as to occasion little inconvenience, or so powerful as to destroy life like a flash of lightning, which, indeed, is nothing more than the spontaneous discharge of an analogous electric arrangement in the atmosphere, or between that and the earth. But to obtain a shock of such extreme violence, it would be necessary to make the bottle of an unwieldy magnitude; and the same end is attained by connecting together a number of bottles by their inner and outer surfaces respectively, so that the whole may be discharged at once. Such an arrangement is called the electric battery, and affords an instrument of immense power.

The current of electric force may, with either the jar or battery, be made to penetrate through the skin, and enter deeply into the body; and, by means of directors connected with the opposite excited surfaces, may be conveyed from one end of the body to the other, or through it from side to side, or from one part to another of a limb, or through very limited portions of the body, at the pleasure of the operator. The directors must of course have insulated handles, and their knobbed free extremities must be applied at the opposite extremities of the part through which the current is to pass. If the object be to direct the electricity into a single muscle, both extremities, as directed by M. Duchenne, should be applied immediately over the muscle, with the space of an inch or more between them.

A repetition of graduated effects may be obtained through the jar, by placing its ball in communication with the excited prime conductor, and its external surface, in any convenient method, with one of Lane's electrometers, in such a manner, that the ball of the electrometer shall not be in absolute contact with it, but within striking distance of the electrical spark. By means of chains, insulated directors may be connected with the prime conductor and the electrometer, and their knobs applied at the required points of the surface. When the machine is set in motion, and the jar becomes charged, at the moment of connection through the body, the electrical current passes between the knob of the electrometer and the outer coating of the jar, to establish the equilibrium. If the intervening space is large, the shock will be necessarily severe, for great tension will be necessary to overcome the resistance of the air; if very small, the shock may be slight; so that its severity may be regulated by regulating this interval, and at the same time attending to the working of the machine. Care should be taken that the jar should be fully discharged before commencing operations; and then the handle of the machine should be turned more or less frequently, and more or less rapidly, according to the effect required.

b. *Excitation by Contact and Chemical Action.*

Galvanism, or the *dynamic form of electricity*, is excited by the contact of two metals, or other conducting bodies, with the presence of a fluid capable of chemical action on one only of the two, or on one more than on the other. A change of electrical condition takes place in the one most easily affected chemically; the other assumes an opposite condition; and at the moment of communication between them, whether by the absolute contact of the two, or by means of another metal, an attempt to restore the equilibrium takes place, with the effect of developing electrical phenomena. The apparent current of force is from the metal chemically affected, through the liquid, to the one not affected, and then through the connecting material to the point of origin. But, as the cause is constantly operating, the electrical condition is constantly disturbed, and no equilibrium is in fact established, but a constant circle of action maintained until the exciting agency is exhausted. Anything susceptible of change by electrical influence, if placed in the circuit, will feel the effects in a degree proportionate to its susceptibility, and the force developed. From a simple circle, as above described, but slight effect is obtained; yet enough to be very sensible.

To increase the effect, these simple circles or elements must be multiplied, so as to form what are called galvanic batteries, or voltaic piles; and the power developed is in proportion to the number of the elements employed. Numerous methods of attaining this end have been devised, which it is not my object to describe. One thing is common to all of them; namely, that the associated metals, or other conductors, in each pair, and the several pairs themselves always bear the same relation to one another; and the successive pairs must be connected by a conducting medium. The extremes of the arrangement are consequently of opposite character; and, when they are made to communicate, the accumulated force of the whole battery is exerted in the line of communication. These extremes are usually denominated poles, the one at which the metal most acted on is placed being the negative, and the other, towards which the current of force is directed, the positive.

Zinc and either copper or silver are the metals usually chosen, and a diluted acid, especially the sulphuric or nitric, the exciting and conducting liquid; but other metals and other liquids, and even non-metallic substances may be substituted, and various other arrangements have been shown to have a similar agency; chemical action, however, being common to all.

As before stated, the tension of galvanic electricity is very slight, and consequently but slight sparks are afforded by approaching the poles, and relatively slight sensation produced; but the influences dependent on quantity are strong, such as chemical decomposition, the development of caloric, and, in the animal system, the production of organic change.

Application. The simplest galvanic arrangement may be applied with great facility. A small circular or oval plate of zinc, and a silver coin an inch in diameter, placed in the mouth, one above and the other below the tongue, and then allowed to touch, afford evidence of their action to the sense of taste; and a similar pair, soldered together, may be used for very gentle stimulation to these parts; the saliva acting as the exciting liquid.

Another simple arrangement is to place upon two separate parts of the body, between which it is desired to establish a galvanic current, two thin oval or circular plates of zinc and silver, an inch or two in diameter, one on one of the parts, and the other on the other, and to connect the two by means of a delicate wire attached to an eye, upon the outer surface of each plate. The skin beneath should be moist, so as to allow the galvanic influence to penetrate through the cuticle, which is a bad conductor; and for this purpose a layer of any wet conducting substance may intervene between the plates and the skin. Even distant parts of the body may be connected in this way.

Galvanic Chains. A series of small hexagonal plates, composed each of a zinc and a silver plate soldered together by one of their surfaces, and connected by wires so as to move freely, forms a sort of chain, which may be worn next the body, and becomes active through the perspiration. The *chain of Pulvermacher*, made of couples of minute coils of wire around cylinders of wood, and connected together by wire, acts with considerable energy. The number of elements may extend to several hundreds. Excited by being steeped in an acid liquor, it continues to act for several hours, and may be usefully employed in the treatment of superficial affections. The advantage of these and other arrangements with small elements is, that the peculiar galvanic stimulation may be obtained with less of the heating effect, which is proportionate, in some degree, to the size of the metallic plates, while the former depends more upon their number.

Batteries or *piles* are made of various forms, and of variable numbers of pairs, according to the amount of effect desired. They are applied by means of wires connected at one end with their opposite poles, and terminating at the other in various modes for convenience of use, by which the galvanic influence is conveyed to the person at any distance from the battery. These conductors must be insulated, in some portion of their course, by glass tubes or otherwise, so that the operator himself may not interrupt the current. Of the different methods of termination of these conductors more will be said, in connection with other electric arrangements to be considered immediately. I may mention here that the object is sometimes effected by applying the agency through the medium of water. Thus, both feet may be placed in vessels of water connected with the opposite poles, or both hands, or one foot and one hand; and thus the currents varied in their direction through or over the body. Indeed, the whole body may be immersed; so that, when the bath is connected with one pole, and the body with the other, the electric current may diffuse itself through the system, in its attempts to escape at the surface. Disadvantages of the ordinary batteries used for chemical purposes, as Cruikshank's, Wollaston's, etc., are the disagreeable odour given out in consequence of the decompositions which take place, their unwieldy size, and the difficulty of suitably regulating their action. They are not, therefore, much employed; though circumstances occasionally arise which render a resort to them advisable.

The ordinary galvanic batteries, though they give a continuous current of a certain duration, are unable to furnish that continuity and duration of the galvanic action which is necessary to fulfil all the demands of the most recent galvanic therapeutics. To obviate this defect, several batteries have been contrived, known from their authors as Grove's, Bunsen's, and Daniell's batteries, which have stood the test of trial, and one of which is now generally used, where the greatest simple galvanic effects are required.

c. *Excitation by Magnetic Induction.*

When a magnet is placed within a coil of wire insulated by being covered with silk thread, the latter assumes a polar condition the reverse of that of the magnet; and, if the magnetic circuit and that of the coil be closed at the same time, a current takes place in the latter in a direction opposite to that of the former. A powerful horse-shoe magnet is thus capable of inducing an electric movement in a coil of wire, which gives rise to sensible phenomena, and with certain arrangements may be made to act with great energy. When the body is connected with the two opposite poles by any conducting material, a slight shock is felt upon the closing of the magnetic circuit, after which no sensation is perceived, and no obvious effect produced, until the circuit is broken, when another sensation stronger than the first is experienced, by the instant alteration of the current before its entrance into repose. If, by any contrivance, this interruption of the circuit be made rapidly, the quick succession of the shocks becomes painful, and the effect may be increased so as to be quite insupportable. Upon this principle it is that the electro-magnetic machine is composed.

Electro-Magnetic or Magneto-Electric Machines.

Different machines of this kind have been devised by different persons. Among them probably those of Clark, Dujardin, and the Messieurs Breton are best known. The current is broken in these instruments by a rotary movement given to the armature of soft iron, by which it is alternately brought into and removed from apposition with the magnet; but the coil of insulated wire, called the intensity coil, is in some of them placed around the armature, and in others around the magnet. This difference is of no great account, as the armature always becomes temporarily a magnet when in connection with the proper magnet, and consequently induces a current in the coil around it. But M. Duchenne, considering none of them capable of effecting all the objects attainable by a perfect machine of this order, endeavoured, by combining the best parts of those in use with improvements of his own, to make an instrument approaching nearer to his conception of what is desirable than any one hitherto invented. As this instrument, at the time when the first edition of this work was published, was, I believe, quite unknown in this country, I gave in a note a figure of it copied from one in M. Duchenne's treatise, with his explanation of its construction and principles. This description, as no longer necessary, has been omitted in the second and present editions. I would simply state, in relation to the instrument, that the chief additions made by M. Duchenne were a graduator of the currents, by which the intensity may within certain limits be increased or diminished at pleasure, and a second superimposed coil of insulated wire, much finer than the first, by which the intensity is greatly increased, and which, though used in the volta-electric machines, had not previously been applied to the electro-magnetic.

d. *Electric Excitation by Galvano-magnetic Induction.*

If within a coil of insulated wire a piece of soft iron be placed, and a galvanic current be passed through the coil, the soft iron becomes magnetized, and continues so as long, and only as long, as the current is maintained. Now this temporary magnet exercises an inductive power on the wire, similar to that produced by a permanent magnet, and increases the force of the galvanic current in the former. If, over the coil of wire alluded to, another be placed consisting of smaller wire, this also acquires an induced state of electric action, and the intensity of the galvanic current is still further augmented. If, again, the current be interrupted, phenomena are produced of the same character as those already referred to as resulting from a similar interruption of the current in the electro-magnetic apparatus. Upon these principles instruments have been invented for the therapeutic application of electricity, which have of late been much in use, and, together with the electro-magnetic machine, have almost superseded the methods formerly employed.

Volta-Electric Machines. Galvano-Magnetic Induction Machines. Electro-Dynamic Machines.

A large number of these machines have been contrived in Englan[illegible] France, and Germany, as those of Newman, the Messrs. Breton, Keller, etc. The following are the essential parts of the apparatus: 1. a *primary* and *secondary coil* or *helix* of insulated wire; 2. a *bundle of soft iron wires* to be introduced within the coil; 3. a *contact-breaker*, by which the current is interrupted, and which is made to act through the influence of the galvanic current itself; 4. a *galvanic battery* or *pile*, consisting of one or more pairs, which is to furnish the influence by which the whole apparatus is set in operation; and 5. a pair of insulated metallic *directors* or *conductors*, which are to be connected with the poles of the apparatus, and by means of which the electricity is applied to the body. The terminations of these directors are called by M. Duchenne *excitors*, and are of various character and form to meet special indications. (See *page* 509.)

To put the machine in operation, the galvanic battery is first made to act, and the electric influence is conveyed to the ends of the larger and inner wire, which thus becomes the connecting medium between the poles of the battery. A galvanic circuit is thus established, the intensity of which is greatly increased by the reaction upon each other of the spirals through which the influence is propagated. At the same time the bundle of wires within becomes magnetized, and the outer wire acquires an induced state of great energy, and in an opposite direction to the original current. It is, however, by the frequently repeated interruption of the currents that they acquire their great physiological and remedial power, as in the electro-magnetic machine. The contact-breaker which produces this effect operates on a very simple principle. A slip of metal movable at one end, and kept in its place by a spring, is so situated that the movable end forms a part of the circuit, which passes through its point of contact. But being also near, though not in contact with the iron which becomes magnetized by the current, as soon as this is established, it is attracted by the magnetic force, and separated from its previous connection. The circuit is thus broken, the magnet loses its power, the attraction ceases, and the spring forces the movable slip back to its original position. This restores the current, and the same operation is repeated as before; so that there is a constant and rapid succession of intermissions, as long as the machine acts: the contact-breaker producing a sensible sound, as it flies rapidly backward and forward between the metallic boundaries of its movements.

The wires which serve to convey the influence of the machine to the patient, and which are of course attached to its opposite poles, are often themselves made to increase the intensity of the current, by being thrown for a portion of their length into the spiral form.

I shall not attempt to describe the various instruments employed, and must content myself here with referring the reader to a note, in the first edition of this work, in which an account is presented of one of the most recent and most perfect, which has been arranged by M. Duchenne. By consulting this account, he will be put into possession of all that will be necessary to enable him to understand and apply not only this, but other apparatuses of the same kind.*

---

* *Excitors, or Terminations of the Directors.* Before proceeding to treat of the effects of electricity on the system, it will be expedient to make a few remarks on the different modes of application, by the directors.

The form of the terminations of the free ends of the conducting wire or chain, by which the influence is conveyed to the patient, is of some importance. These terminations are called *excitors* by M. Duchenne. When electricity is to be applied by the aura, they should be pointed; when by sparks, rounded; when by contact, they may be of any form which the practitioner may deem most convenient; the mere touching of the excitors by any part of the surface being sufficient. *Spherical, olive-shaped,* or *conical* terminations (Fig. 2) are very common. Sometimes cylindrical pieces of metal are used, which the patient can hold in his hand. Sometimes a metallic shoe is made to fit the foot, which terminates one pole, while the other is applied to some other part of the body. The excitors may be straight or variously

Fig. 1.

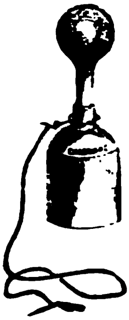


Fig. 2.

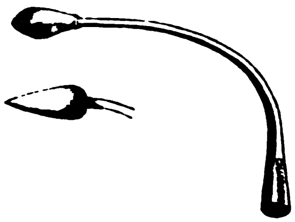
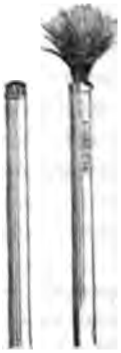


Fig. 3.



curved, and when to be applied by an operator, must, as before stated, have an insulating handle.

It is often necessary that the surface of the body to which they are applied should be moist, to enable the influence to penetrate through the cuticle. In such

2. *Effects of Electricity on the System.*

As electricity is probably identical under whatever aspect it may present itself, its effects under similar circumstances are probably also identical; but, in the different conditions in which it is actually developed, it exhibits striking differences of operation, which render necessary the consideration of it, in the present relation, as before in regard to the methods of development, under its several distinct forms. Its characteristic effects, as a general rule, are to excite sensation and muscular contraction, and, indeed, to augment the functions of all the organs on which it may be brought specially to act; consequently, under favouring circumstances, to promote digestion, absorption, circulation, animal temperature, secretion, and the nutritive and assimilative processes; in other words, it appears to be capable of acting as a universal stimulant, though more especially directed to the vital properties of sensibility and muscular contractility. In its influence upon sensation, it produces effects corresponding with the functions of the several senses; causing pain, when acting on the nerves of general sensation; the perception of light, when on the organ of vision; a peculiar taste, when on the tongue and palate; smell, when on the olfactory organs; and sound, when on the ears. Muscular contraction is caused by it, whether directed to the muscle exclusively, to the nerves of motion, or to the nervous centres of motion In the higher exertion of its powers, like some other stimulants, it has the effect of overwhelming the vital functions, and producing apparent direct prostration, even to a fatal issue. Witness the effects of a violent shock, and especially of a stroke of lightning, which often destroys life instantaneously, and, when it fails to do this, generally leaves the patient for a time more or less prostrate, senseless, and paralyzed.

a. *Effects of Electricity Excited by Friction.*

The effects of a mere accumulation of electricity in the system have not been satisfactorily determined. We feel often very differently before and after a thunder-storm. Many persons imagine they can detect by their sensations the approach of certain changes in the weather, before any evidence of such changes is presented by ordinary signs. I know neuralgic persons who suffer much more in certain kinds of weather than in others, though completely protected against any influence of cold or

---

instances, the ends of the excitors should be covered with buckskin or other similar material, which will imbibe and retain moisture. A sort of hollow cylinder containing a wet sponge (Fig. 1) should be used, when it is desirable to cover some extent of surface. M. Duchenne uses sometimes a bunch of fine wires, in the form of a brush or broom (Fig. 3), the wires being fixed at one end in a hollow cylinder, from which they project at the other, and the cylinder being screwed upon an insulating handle.

moisture. These results have been vaguely ascribed to the electrical condition of the system, and possibly with some justice; but it would be difficult to adduce positive proof of the fact; and, when we attempt to reduce the phenomena within any general rules, they quite elude our grasp.

Silent Conduction. When the body, by contact with an excited prime conductor, becomes the route through which the electric current passes, however powerful may be the machine, and however rapid the current, no observable effect is produced either upon the sensations, or any of the functions.

The Aura. This is said to operate as a mild stimulant to the portion of surface upon which it is made to act; and has sometimes been employed for this purpose in affections of very delicate organs, as the eye. But the influence, if any, must be extremely slight.

The Electric Bath. Very different statements have been made as to the effects of electricity accumulated in the system, in a state of insulation. Some have found it to increase the frequency of the pulse, and promote the secretions, especially those of the skin, kidneys, and salivary glands, and have obtained great supposed advantages from it in rheumatic neuralgia, and paralytic diseases. Giacomini, while admitting that the positive electric bath produces no impression on any one of the interior functions, imagined the negative to be powerfully depressing, and capable of advantageous use as a contra-stimulant agent. It is not impossible that, in certain very susceptible individuals, the bath may have some influence; but I have found no effect from it in my own person, and the same I believe to be the experience of most who have tried it; and, without calling into question the accuracy or trustworthiness of those who have made opposite statements, we are, I think, justified in at least suspecting, that the phenomena observed were really ascribable to the mental state of the persons acted on, and in no degree to the electricity. As to the supposed cures of rheumatism, neuralgia, and palsy, we know well how powerful mental influence is in many cases of those affections, and how often the favourable changes which have taken place spontaneously with time, have been ascribed to the last remedy used. But, though we may doubt the remedial influence of simple electrical accumulation, yet the bath may be made a means of gentle stimulation to the surface, by the sensation produced when the electricity is drawn from the body, under these circumstances, by sparks.

Sparks. The spark, whether drawn from an excited prime conductor by the body, or from the excited and insulated body by other substances, is attended with more or less sensation, of a sharp, pungent character, very slight when the spark is small, but painful when the electric tension is very great, though seldom so severe that it cannot be readily borne. The electricity scarcely penetrates beyond the surface; yet it in some degree excites the skin, and, if the operation is continued, produces rubefacient swelling, and some tenderness to the touch. It may therefore, be occasionally used with advantage in this method, as a gentle excitant in inactive states of the surface, and as a revulsive in internal diseases of no great severity. It may be concentrated in one spot, or applied extensively over the surface; and, for the latter purpose, the bath probably affords the most convenient means. By the interposition of flannel, which may cover the ball of the director, or be applied to the surface of the body, a great number of minute sparks may be drawn rapidly, with less discomfort to the patient.

Leyden Jar. When the body is made the connecting medium between the two surfaces of a Leyden jar, a quick painful sensation is experienced, denominated the shock, which is always disagreeable, and may be so violent as to be quite insupportable. This is attended with a quick, jerking, muscular contraction, and even the deep-lying muscles may be brought into energetic action. If applied to the hands, the sensation is felt chiefly in the wrists, elbows, and breast. If directed so as to reach the nervous centres, the shock radiates through the whole system. When severe, its first observable effect, independently of the sensation and spasm produced, is to depress function by overwhelming it. Thus, the skin for a short distance around the point of entrance is whitened, and its temperature lessened, while the follicles project in consequence of the shrinking of the tissue. The part is also more or less benumbed. If the shock is passed through a nerve of sensation, numbness is apt to be felt in the parts supplied by it; and a severe shock through the brain or spinal marrow, produces, in the former case, mental confusion, forgetfulness, dimness of vision, etc., in the latter, feebleness approaching to paralysis of the lower limbs. The violence of the effect is proportionate both to the electric intensity and quantity. A small jar, highly charged, will produce a greater effect than a larger one feebly charged; but, the intensity being equal, the degree of effect is then proportionate to the quantity, or to the magnitude of the apparatus. The shock from an electric battery is capable of producing temporary insensibility, and probably death. After fatal effects from lightning, streaks of redness are said to be sometimes observed along the surface; and the blood is, in general, fluid, and the muscles flaccid, as if universal death had taken place immediately. The depression occasioned by the shock from the jar speedily passes off, and is followed by more or less reaction. In this method of application, electricity may sometimes be usefully employed for exciting parts which lie deeply, and are extremely insusceptible, or in rousing a torpid system by the shock, or for depressing nervous excitement by its first overwhelming effects; but it is impossible to limit its action precisely to any one muscle or part; and there may be hazard, in cases of great depression, of dangerously adding the prostration of the shock to that already existing. Allusion has been before made (see *pages*

502–3) to a mode of regulating the remedy which will obviate this latter danger. In some instances, the subcutaneous adipose tissue is so thick, or the cellular tissue so edematous, that the dynamic currents will not penetrate them. In such cases recourse may be had to the jar.

b. *Effects of Dynamic Electricity.*

This includes both galvanism, strictly speaking, and the electricity developed by induction. Dynamic electricity differs, in its attendant physiological phenomena, materially from the static. It produces sensation, but in a much less degree, in proportion to other effects. Thus, a galvanic battery, capable of powerful chemical action, will give only a slight tingling sensation to the part at which the current enters; while the continuance of the current gives rise to effects which never proceed from a continuous current of machine electricity. The dynamic current causes also contraction of the muscles, and even energetic contraction, but without the violent shock to the system produced by the other form. Another important point of difference is that its influence can be directed to a certain part, and in a considerable degree limited to that part; so that a diseased muscle, for example, which may have lost its sensibility, and in which the electric stimulation may be strongly indicated, may be acted on by means of the galvanic or inductive current, with little or no disturbance or injury to neighbouring and more excitable tissues. This alone gives a vast superiority to this form of electricity over the static, as a therapeutic agent. For the methods of effectually localizing the action of galvanism, we are greatly indebted to M. Duchenne. Formerly no attempts of the kind were made, or quite ineffectually, until the method of acupuncture was applied by M. Sarlandière to this object; but the necessity for this has been superseded by the methods of M. Duchenne, which, while less unpleasant, are even more effectual.

1. *Effects of Galvanism.* In the physiological operation of galvanism, there are effects produced which cannot be completely separated, and which often interfere injuriously with one another when the agent is employed therapeutically. The current may be either continuous or intermittent: and the effects of the two modes of application differ materially.

The *continuous current*, while it produces sensation in the skin, exercises also an influence over the organic actions, giving rise to heat, irritation, and inflammation in various degrees, according to its power and continuance, sometimes ending in absolute cauterization. The most powerful current, if introduced into a muscle, occasions but slight, irregular, or partial contractions, while it causes a sense of burning heat, even in the depths of the tissues along its course.

In the *intermittent current*, the organic action of the battery, or its tendency to produce heat, inflammation, and disorganization, is diminished; while its power of exciting sensation and muscular contraction is greatly increased. This difference is readily explicable. At every breaking of the current, there are three physiological actions; one at the entrance of the current, one at its cessation, and a third in the interval. Sensation and muscular contraction are produced chiefly at the entrance, and much less at the moment of interruption, while in the interval, or during the continuance of the current, there is little comparative influence on the sensibility, none or scarcely any on muscular contractility, but a strong tendency to provoke inflammation or organic change. It follows, therefore, that if the current be frequently interrupted, sensation and contraction will be proportionably increased, and organic action diminished; and thus the intermittent current can be more effectively applied to the former purposes, the continuous to the latter.

There is one effect which, according to M. Duchenne, the galvanic current produces beyond all other modes of electric action. It has great influence on the organ of vision, and, if made to operate on the face or scalp, where the fifth pair of nerves, which are mainly sensitive, are distributed, it occasions dazzling luminous sensations. These flashes are produced strongly at the entrance of the current, feebly at its cessation, and very slightly, so as to be appreciable only in a dark room, during its continuance. By a rapidly recurring intermission of the current, there may be kept up a constant succession of the luminous phenomena. They are produced chiefly on the side to which the application is made, more powerfully as the median line is approached, and on both sides, when the excitors connected with the two poles are both placed at that line. An important inference is deducible from this fact, in determining the therapeutic application of the agency; namely, that galvanism is to be preferred when the indication is to excite the retina, and its application to the face avoided in the opposite indication.

I need scarcely state that the interruption of the galvanic current may be effected by withdrawing the excitors, and a succession of intermissions more or less rapid obtained, by their more or less rapid withdrawal and reapplication.

But there is much inconvenience in this manual operation; it is almost necessarily effected comparatively slowly and irregularly; and, even at best, the continuous current, while it lasts, is exercising its organic influence, and may at times be productive of great inconvenience. While, therefore, the galvanic battery is preferable in all cases in which the object is to excite inflammation or other organic change, it is highly desirable to obtain the means of exciting at will the nervous properties of sensibility and muscular contraction, without endangering the integrity of the tissues. Such means are supplied by the form of electricity developed by induction, whether through the electro-magnetic, or volta-electric instruments.

2. *Effects of Induced Electricity.* In the operation of the instruments above referred to, it is at the moments when the circle is closed, and

when it is broken, that the effects are produced; no phenomena whatever being excited between these two points of time. While the circle remains closed, the electric force appears to be quite quiescent. This is the important point in which the induced electricity differs, in its physiological and therapeutical effects, from the galvanic. That the fact is as stated may be shown by a simple experiment. If a frog's muscle be placed in the electric circle, it contracts instantaneously when the circle is closed, then becomes perfectly quiescent, and continues so until the circle is broken, when it again contracts, and more strongly than at first. But, though there are thus shown to be two actions, one at the closing, and the other at the breaking of the current, it is only the latter which is strong enough to be effective in the human subject; the one occurring at the closure of the circle being scarcely perceptible, though sufficiently powerful to produce contraction in the muscles of a frog. It is to this power of strongly exciting sensation and motion, without producing inflammation, that the inductive instruments owe their great superiority, as therapeutic agents, over other galvanic arrangements, for the general purposes which are aimed at in the use of electricity. However powerful their operation, or however long continued, though they may produce insupportable pain, and the most energetic muscular contraction, they never cause disorganizing inflammation; and, though a little erythematic redness of the skin may be produced, with erection of the papillæ, the effect quickly subsides upon the cessation of the action.

It is obvious that, the more rapid the succession of the intermissions, the more rapid will also be the succession of the muscular contractions produced by them; and thus a method is offered of controlling the effect, to a considerable degree, by diminishing or increasing the number of intermissions. The contractions, however, are severally more powerful, when at long than short intervals; but, by their very frequent repetition, the muscle may be kept in an apparent state of steady contraction, similar to that produced under the influence of the will. There is a sort of vibratory movement in the fibres; but, to the touch, the muscle feels as though steadily contracting. An influence analogous to the healthful stimulus is thus obtained, which has a tonic effect on the muscle, and promotes its nutrition. Hence its application in cases of relaxation from debility, and in atrophy of the muscles. Though the contractions are more powerful at long intervals, yet, in relation to sensation, the more rapid the succession of intermissions, the greater is the effect. Hence, when it is important to awaken sensibility, as in cutaneous paralysis, the instrument should be made to act rapidly. On the contrary, a rapid movement is contraindicated in disease of the brain, upon which the pain may react injuriously; in cases of great natural susceptibility; and in operating on delicate organs, as the tympanum of the ear, different parts of the face, and the testicle.

But this is not all the merit of these machines. By varying th mode of application, different physiological effects are obtained, each susceptible of beneficial therapeutic use. Thus, the current of the two wires, the larger and smaller, or, as M. Duchenne designates them, the currents of the first and second order, differ materially in their effects. The machine with the double wire operates much more powerfully on the face and eyeballs in producing luminous phenomena than that with only one wire; and the effect, according to M. Duchenne, is much greater from the electro-magnetic than the volta-electric apparatus. Even with a feeble action of the former, considerable reaction is produced upon the retina; while the latter operates in this way only when somewhat intensely excited, and when the excitors are applied to the emerging points of the fifth pair, or to the globe of the eye itself. The current from the first order (larger wire) of the electro-magnetic instrument produces no stronger an impression than the volta-electric. But the luminous phenomena, excited by these machines, even by the second current of the electro-magnetic, are much feebler than those which result from simple galvanism.

Moreover, the current of the first wire appears to have a special influence over muscular contractility, that of the second over cutaneous sensibility; that is, though both currents act on both properties, yet one produces a greater relative effect on the one, the other on the other. (*Electrisation Localisée*, pp. 15, 16.) Cutaneous insensibility will often yield promptly to the current of the second order (small wire), when that of the first has no effect whatever; but, in very susceptible persons, it will be advisable to have recourse to that of the first or larger wire, because less disturbing to the sensibility.

3. *Methods of Application.*

In describing the instruments for the development of static and galvanic electricity, and the effects of these two modes of electrical excitement, I have probably said as much as may be necessary in relation to their method of application. But the following observations upon the application of induced electricity, derived almost exclusively from the work of M. Duchenne, appear to be necessary, to place the reader on a level with the state to which therapeutical electrization has been brought by that indefatigable investigator.

1. *To the Muscles.—Faradisation of the Muscles* (Duchenne).*—To

---

* The term *faradisation* was invented by M. Duchenne, and applied in honour of the distinguished chemist, Faraday, who has done so much for electrical science. As the name of *electricity* is given to the static form of this agency, and galvanism to that developed by contact, with chemical action, M. Duchenne considered himself authorized to give that of *faradism* to the induced form of dynamic electricity, and *faradisation* to its application. (*Note to the second edition.*)

affect the muscles, we may operate either through the nervous plexuses and trunks, or directly on the muscles themselves. In the former case, we necessarily influence at the same time several associated muscles; in the latter, we may limit the action to a single muscle.

The two excitors, or terminations of the directing conductors, should be placed near to each other, at distances varying from one to four inches. If the skin is well moistened, the electric influence penetrates readily through it to the parts beneath. When it is required to operate on the larger muscles, as those of the trunk for example, the cylinder with the moist sponge (Fig. 1, *page* 509) should be used. For small muscles, as those of the face or intercostals, or for deep-seated muscles, the conical excitors (Fig. 2, *page* 509), covered with thoroughly moistened leather, as the finger of a glove, are to be preferred. The latter also are preferable when it is desirable to excite the muscles through a nerve. The moist skin is a better conductor than the wet sponge; and, when a powerful effect is demanded, the conical excitors may be sometimes advantageously used even for large muscles, being in this case moved from point to point. To apply the instrument efficiently, the practitioner must of course have made himself acquainted with the precise situation of the muscles, and course of the nerves supplying them. Their depth below the skin must also be well understood. The influence is never to be directed to the tendons. To act on a muscle duly, its whole surface must be covered; and consequently, if this is large, the excitors must be moved from point to point successively until the purpose has been accomplished. The muscle is known to be contracting by its firmness or hardness under the fingers; and it often happens that one part of a single muscle will be relaxed, while another contracts. The thicker the muscle, the more intense must be the current applied. In the face, it is difficult to avoid affecting the nerves so abundantly distributed over it. One of these is known to be touched when the contraction extends to several muscles simultaneously. Should this happen, the excitors should be moved a very short distance from the point, until the effect is no longer produced.*

When a muscle, on account of its depth, cannot be reached directly by the electric influence, it may be excited by means of its supplying nerve. The excitement of a nerve, or of a muscle, always produces in the healthy state both a sensation and contraction. But the susceptibility of different nerves and muscles is very different in degree; and a force which will affect one but slightly, will on another act with great energy. Again, while one part is unusually excitable in relation to contractility, another is more so in relation to sensibility. It is against the latter that the operator must be particularly on his guard, prepared to withhold his hand, or diminish the force of the instrument, when the influence becomes excessive. Sometimes the sensibility to pain is so great as to preclude this method of electrization. It is apt to be particularly strong in the muscles of the face, supplied by the fifth pair. The excitor should never be placed over the points corresponding with the suborbitar or mental nerve; and the excitation of the frontal nerves produces severe pain, which radiates through the head. The muscles of the eyelids, of the alæ nasi, and of the upper and lower lips, are peculiarly susceptible. Of the muscles of the neck, the platysma myoides, the upper half of the sterno-mastoid, and the external edge of the upper half of the trapezius, are much more excitable than the remainder. The great pectoral and the muscles of the subspinal fossa are rather sensitive; the deltoid and the muscles of the arms somewhat less, the anterior being much more so than the posterior. The long dorsal and the sacro-lumbar are but slightly sensitive. The gluteal and fascia lata muscles are very much so, compared with those on the outer and posterior parts of the thigh; those of the internal crural region more so than those of the external. The posterior muscles of the leg are but slightly sensitive compared with the anterior and external.

---

* M. Duchenne found that the muscles contract most readily if certain points are touched by the excitors. Dr. R. Remak, of Berlin, ascertained that these points correspond with the points at which the nerves enter the muscles; and that the degree of contraction produced is exactly proportionate to the number of motory nerve fibres embraced by the current at its place of entrance. (*Med. Times and Gaz.*, May, 1858, p. 479.)—*Note to the second edition.*

At the moment of contact, even when the surface is moist, severe pain is sometimes felt in the skin, which soon ceases. In such cases, in order to obviate the effect, the excitors should be brought into contact before application, so as to restore the equilibrium, and then gradually separated to the necessary distance.

2. *To the Skin.* If static electricity is employed for exciting the skin, it is necessary that it should be of feeble intensity, as it would otherwise penetrate the deeper tissues. The dynamic form is preferable; care being taken to have the surface of the excitors quite dry, so as to confine the influence to the skin. But the electricity of induction, the *faradism* of M. Duchenne, is here specially advantageous, when mere excitation without organic disturbance of the surface is wanted; as it never, like galvanism, produces severe inflammation or cauterization. If, however, a powerful revulsive effect is desired, for the relief of chronic internal affections, galvanism is preferable.

An excitor containing the moist sponge having been applied to one point of the surface, the other excitor, quite dry, is to be held by the operator, and, after the skin has been thoroughly dried by rubbing upon it lycopodium or other absorbent powder, is to be passed rapidly over the part; or cylindrical or olive-shaped dry excitors may be moved from point to point over the skin. Sometimes advantage may accrue from using the wire brush (Fig. 3, *page* 509) as an excitor, which may be moved over, or struck lightly on the surface. M. Duchenne calls this latter process *fustigation.* The wires may also, in certain cases, be kept in contact with the skin; but this cannot be long borne, in consequence of the violent pain produced. The latter mode of electrization he calls *electric moxa*, as having, I presume, the powerful irritant and revulsive influence of that agent, without its organic results. It is applicable only when there is great cutaneous insensibility, or it is desired to promote the dispersion of white swellings, and other chronic tumours or tumefactions.

The application of the electrified hand of the operator, under the influence of an intense current, excites lively sensation in the face, but is insufficient for other parts of the body. The rounded metallic excitors act powerfully on the face, even with a slight intensity of current, and sufficiently on the skin of the trunk and other parts of the body, except that of the hands and the soles of the feet. For the last-mentioned parts the wire brush must be used, which has three times the power of the blunt excitors. The inner and middle parts, however, of the soles of the feet have more susceptibility.

No single therapeutic agency is so efficacious in exciting cutaneous sensibility as "faradisation." It may be graduated to any required degree of impression, from a slight tingling to the most violent pain; the excitement in its higher grades is not exceeded by that of a burn, yet no disorganization takes place, not even so much as vesication; it may be carried rapidly over the whole surface of the body; and the pain subsides instantly, and almost completely, when the operation ceases.

To Internal Organs. Most of these may be reached either directly by the excitors, or through the nerves which supply them.

In affections of the *rectum*, one of the metallic olive-shaped excitors, upon a stem insulated by a covering of caoutchouc, may be introduced into the bowel, while the other is carried from point to point about the anus. If the sphincters are debilitated or paralyzed, the excitor may be brought into apposition with them; if the muscular coat of the rectum, it should be passed successively over the whole inner surface of the bowel. Constipation, incontinence of the feces, and prolapsus of the rectum may often be advantageously treated in this way. In the same manner, the hypogastric plexus posterior to the rectum may be excited.

The *bladder* and *rectum* are but slightly sensitive to pain from the electric impression. The latter, therefore, may be resorted to in operating on the former, an excitor being introduced into both; but care must always be taken, in using instruments for the purpose, that the stem should be completely insulated. The vesical excitor may be carried over the whole surface of the bladder. Should the rectum be too irritable for the purpose, the two excitors may be introduced through a double caoutchouc canula into the bladder; the instrument being so contrived that the excitors should not be allowed to meet. The bladder, however, should be quite emptied of urine, as this fluid would otherwise serve to connect the poles.

The *uterus* may be operated on by a somewhat similarly contrived double instrument. This organ also has but little sensitiveness unless in pregnancy.

The *pharynx* may be entered by an olive-shaped excitor, properly supported, which may be passed along the posterior part, while the other pole is applied to the nape of the neck. It is necessary to avoid the lateral portions of the pharynx, for fear of injuriously exciting the pneumogastric, glosso-pharyngeal, and accessory nerve of Willis, which are in this vicinity.

In complaints of the *larynx*, as *aphonia*, one of the excitors may be passed down the pharynx below the posterior part of the larynx, while the other is applied, moistened, to the external parts answering to the crico-thyroid muscle. The inner excitor is then to be brought forward against the larynx, and passed upwards and downwards.

The *stomach*, *liver*, *lungs*, and *heart* cannot be acted on directly, but may be reached through the pneumogastric nerve. By making the application to the lower portion of the œsophagus, which may be done by the introduction of a suitable instrument, insulated by a caoutchouc covering, except at its extremity, and placing the other excitor at the pit of the stomach, the influence may be directed to the stomach and liver. If the upper part of the nerve is acted on by applying the pharyngeal excitor to the upper and lateral part of the pharynx, and the second to the nape of the neck, all the viscera mentioned will be put under the electric influence. But these operations require much caution, as the vital organs concerned might be unduly and dangerously affected; and M. Duchenne relates a case, in which a patient fainted under the second of the operations just mentioned, and, upon recovery, stated that he had experienced a feeling of suffocation, and indescribable precordial sensations. On a repetition of the operation, with intermissions of a second, the patient did not faint, but had the same precordial sensation each time.

To the Special Senses. For the *sight*, galvanism is preferable to electricity by induction, as it is more powerfully stimulant to the organ of vision.* If either of the inductive machines be used, the electro-magnetic with a double wire should be preferred, as the more energetic of the two. The application may be made carefully to the ball, and around the orbit.

---

* Dr. Julius Althaus, of London, who is high authority on electrical subjects, states that a very feeble galvanic current applied to the face, such as may be excited by the contact of a silver and copper coin, is sufficient to cause a flash of light; while, if a number of large plates are used, as in Grove's or Daniell's battery, the influence on the retina is so great, that instantaneous blindness might result. The effect is

In operating on the *ear*, the external meatus should be half filled with warm water, and a metallic wire from one of the poles should be introduced into the liquid, while the other excitor is applied to the nape of the neck; or the second excitor, protected by caoutchouc, except at the end, may be introduced through the nostrils, so as to come into contact with the Eustachian tube. As the tympanum, however, is very sensitive, great caution must be observed.

When the electric influence is wanted in the *organ of smell*, a small sound, protected as usual except at the extremity, may be passed over the Schneiderian membrane; when in that of *taste*, the same instrument may be passed over the sides of the tongue and the palate; the second excitor, in both cases, being applied to the back of the neck.

To the Male Genitals. The *testicle* being very sensitive, must be operated on with caution; two excitors being placed near each other upon the scrotum. For operating on the *vesiculæ seminales*, one excitor may be introduced into the rectum, and the second into the bladder, if there be no contraindication; otherwise the latter may be applied on the external surface. In insensibility of these organs generally, the influence should be directed along the whole course of the urethra, as well as to the different parts externally.

Notwithstanding the localization effected by these methods, a secondary influence will sometimes be extended to the nervous centres, against which it is necessary that the operator should be on his guard. The pain itself produced in the part necessarily affects the cerebral centres; and, when care is taken to limit the current by keeping the poles near together, this is the chief, if not exclusive source of general disturbance that may be apprehended. In cases of paralysis of sensation, as well as motion, none of this effect is experienced. The muscle may contract; but, however long the operation may be continued, the patient is sensible of no incon-

---

greater when the current is directed to the mucous membrane, whether of the eye, the nostril, or the mouth, than to the skin, and greater when to the skin previously moistened than dry. But, though thus energetic in its action on the organ of vision, the continuous or galvanic current exerts little influence over the muscles of the face, which are powerfully acted on by faradism or the interrupted current, while the latter has little action on the eye. Hence the great importance of a proper discrimination in the application of the different currents to affections of the face. For deficiency in the nervous power of the retina, galvanism would be the remedy; in palsy of the muscles, faradisation; and if, in the latter case, galvanism should be employed, it would not only do no good to the muscles, but might seriously disturb the healthy vision. (*Med. T. and Gaz.*, Aug. 1862, p. 219.)—*Note to the third edition.*

venience. Even reflex action from the spinal centres is excited by this localized contraction only in certain pathological conditions. But when there is no loss of sensibility, much care is necessary. Certain individuals are, from idiosyncrasy, so exceedingly susceptible, that a slight influence, even insufficient to cause local sensation, occasions faintness, giddiness, dimness of vision, nausea, vomiting, and general feelings of torpor or numbness. These persons are unfit subjects for the use of the remedy. The pain occasioned by the interrupted current has been employed successfully in overcoming the obstinacy often exhibited in feigned diseases. Under the impression that the electricity is employed as a remedial agent, the malingerer, unwilling longer to submit to the pain, acknowledges himself cured by the remedy. (Dr. Addinel Hewson, *Am. J. of Med. Sci.*, Jan. 1861, p. 111.)

Acupuncture. In 1825, M. Sarlandière proposed the direct application of the electric influence to deep-seated parts by means of acupuncture; and, seconded as the measure was by the recommendation of Magendie, it acquired for a time great reputation, and was extensively resorted to. It consisted in introducing very sharp needles through the skin into the part or organ which it was desired to excite, particularly the muscles, and passing the current through them, so that in proceeding from point to point of the needles it must necessarily traverse the part. But the results have not corresponded with the first sanguine expectations, and the measure is at present seldom resorted to. Nor is it now necessary in medical practice; as the methods of M. Duchenne accomplish the same end more effectually and less disagreeably. The objections urged by M. Duchenne against it are, 1. that the electrization of the muscle cannot be separated from that of the skin; 2. that the cutaneous excitement being confined to the course of the needle, surfaces of considerable extent could not be stimulated; 3. that the contractions caused by it are irregular and cannot be foreseen; 4. that to excite the whole of a muscle, especially a large one, so many needles must be introduced that few patients would be found willing to bear the pain; and 5. that, if it be desired to excite the muscle by passing the needle through the nerve, the operation is almost always impracticable. Nevertheless, acupuncture may sometimes be usefully employed by surgeons for the discussion of tumours, and for promoting the coagulation of the blood in aneurisms. Platinum, or gold needles, should be used preferably to steel; as the latter may become oxidized, and thus irritate the parts. When a galvanic battery is used, the parts penetrated by the needle are apt to become inflamed, and a caustic effect is not unfrequently produced.

Great importance has been attached to the transmission of the electric current along the nerve, and in one direction rather than another, in imitation of the course of nervous influence. But much of what has been said on these points has been purely theoretical. M. Duchenne has come to the following conclusions. 1. In man, whatever may be the direction of the currents, or the degree of vitality of the nerves they traverse, the same results are always produced, when the conductors are applied to any portion of the course of the nerves; namely, muscular contractions and sensations. 2. A current prolonged for a considerable time along a healthy nerve, whether it be continuous, or interrupted with rather short intermissions, weakens neither the contractions, the sensations, nor the voluntary movements, and produces no reflex phenomenon above the point excited. 3. A current long protracted in a nerve considerably debilitated, notably lessens its excitability, but without influencing the voluntary motions. 4 Changes in the direction of the current exercise no appreciable influence over the muscular contractility or sensibility in man. 5. Electrization of the terminal nerves of a limb produces sensations only in the points excited. 6. The currents which pass from the nervous extremities to the nervous centres, act principally on the sensibility of the limb, and produce, above the point excited, contractions which are irregular, and little proportionate to the intensity of the sensations. 7. Finally, the mode of electrization, by reflex action, has little efficacy in the treatment of palsy, and sometimes causes persistent neuralgia in the excited limb. (*Duchenne*, pp. 99, 100.) Should there be cerebral lesion existing at the time, it might do serious mischief. (*Ibid.*, p. 97.) A fact worthy of recollection is, that electric excitation of the surface is more effective in bringing on reflex muscular contraction, than excitation of the muscles themselves. (*Ibid.*, p. 33.)

4. *Therapeutic Applications.*

Under the impression that nervous power is nothing more than a form of electricity, which some physiologists were at one time disposed to believe, it was imagined that the latter agent might be made extremely useful in disease, by supplying the deficiency, or correcting the redundancy of the former. Theoretical notions, founded on this basis, have always had, and continue to have more or less influence upon therapeutics. It has been supposed that nervous action in excess might be controlled by the use of negative, and when deficient might be replaced by that of positive electricity. It has been considered important, through the direction of the electrical current, to imitate the natural presumed nervous currents; for one purpose to send the influence in one direction, for another in another direction; to procure in certain cases its transmission by one set of nerves rather than another; in short, to make use of electricity as if it were really the true nervous fluid, and wield it, as that instrument is wielded under the powers of life, for the maintenance of all the functions in their due action and subordination. It is true that this supposition of the identity of the two agents has been quite abandoned, under the irresistible contradiction of experiment;* but there still remains the undoubted and extraordinary analogy between them, to sustain the conjecture that they might operate under similar laws upon the system, and that consequently electricity might, in many instances, be substituted for the nervous influence, if brought to bear on the system in a similar manner. I fear, however, that it will be necessary to abandon this view of the powers and uses of electricity.

With the facts at present known in relation to its effects on the system, it is best to consider it simply as a universal excitant, capable of stimulating any function or organ upon which it can be brought to bear directly into increased activity, and having this special advantage over every other remedial agent, that, by its peculiar nature, it is capable of being directed to, and in a great degree limited in, any part which it may be desirable to operate upon exclusively. It must be borne in mind that it is not by its accumulation that it is capable of fulfilling any therapeutic purpose, but only by movement; and hence it cannot be brought to exert a direct simultaneous influence upon the whole system; for it is scarcely possible so to direct its current, that it should pass at the same time through all parts of the body. It is, therefore, though a universal stimulant, necessarily more or less local in its therapeutic action at any one time.

With its universal stimulant power, it exercises a special excitant influence upon the properties of sensation and muscular contraction; and upon this influence its most important remedial applications are based.

Through the quick and powerful impression it makes upon the nervous centres, commonly designated as the shock, it is capable, if not carried too far, of arousing the whole system, and thus fulfilling another important indication.

By this same shock, in its more forcible application, it overwhelms, and for a time depresses or suspends function; and by a continued excitant influence, it exhausts excitability, and thus may induce secondary depression. It may consequently be made use of occasionally as a sedative agent. In the depressing influence of the shock, it has, if properly managed, this great advantage, that, as it acts mainly on the nervous system, the reaction which follows is also mainly nervous, and, therefore, not disposed to lead to fever or inflammation.

---

* This was demonstrated by the experiments of Matteucci and others; but an observation of M. Duchenne shows, in a striking point of view, the distinction of the two actions, the nervous, namely, and electric. According to that author, the muscles may be wholly insensible to electrical influence, and yet capable of acting under the influence of the will. (*Electrisation Localisée*, etc., p. 402.)

Again, it may, in certain forms, be made to produce inflammation, and thus act revulsively.

The influences hitherto mentioned have been vital. But it also produces chemical effects, of which we may sometimes avail ourselves therapeutically.

From what has been just stated, the following practical indications for the use of electricity may be deduced: 1. to excite any particular function or organ which may be inactive or torpid, and which may stand in need of stimulation; 2. especially to stimulate parts in which sensation or the normal power of motion may be defective or wanting, as in paralytic conditions of the muscular power or general sensibility, or of the special senses; 3. to awaken the system generally from a state of torpor, as in asphyxia, syncope, and the poisonous effects of the narcotics; 4. to benumb deranged sensation, or suppress excessive muscular contraction, as in neuralgia, some forms of rheumatism, and tetanus; 5. to operate revulsively by inflaming or irritating the skin, as in various internal and subcutaneous affections, including chronic inflammations, rheumatism, etc.; 6. to alter morbid nutrition by stimulating the disintegrating process, and thus promoting the absorption of indolent tumours; and 7. through its chemical agency to effect various objects, as the coagulation of the blood in aneurisms, the solution of stone in the bladder, and the extraction of poisonous metals from the system, for all which purposes it has been recommended and employed. It is, I believe, in some one of the above methods, or some combination of them, that it operates as a remedial agent. But to render it practically useful, we must be more precise, and consider severally the various diseases in which it may be used; pointing out in each the particular circumstances which may indicate or contraindicate it, and the particular modes of application most appropriate.

1. *Paralytic Affections.*

It is only by stimulating the paralyzed part, or the nervous centre or nervous trunk supplying it, that electricity operates in the cure of palsy. It is obvious, therefore, that it is wholly inapplicable to cases in which the affection depends upon high vascular congestion, inflammation, or other organic disease of the nervous centres. It is not less obvious that it can be of no use, when similar disease in the connecting nerves prevents the transmission of influence from the centres, even though these may be in a healthy state. Under these circumstances, so far from being serviceable, it may do serious harm, not only when applied directly to the diseased centres or nerves, but even when limited to the paralyzed part; for any excitement in this part reacts upon the nervous centres, and of course upon the nerves which convey impressions to them. But, when all excitement in nervous centres or trunks has subsided, when the organic injury has been repaired, and the continuance of the palsy is owing simply to debility in the centres, or the habit of inertia, or defective nutrition in the paralyzed part, the electric influence is strongly indicated, and often does great service.

The same remark is applicable to cases of palsy from wounds or other mechanical injuries of the nervous centres or trunks. It is vain to stimulate the palsied part until the wound has healed, or the injury been repaired. But after this event, it not unfrequently happens that the palsy persists, and sometimes seems as if it would persist indefinitely, unless the sluggish centre be stimulated, or the paralyzed part restored, by suitable excitation, to its proper organic condition and due sensibility. Perhaps, under these circumstances, no one agent is so efficient as electricity, because no one can be brought to bear so accurately upon the seat of the disease.

It must be observed that, in thus limiting the power of electricity in paralytic affections, I have reference to the excitant power of the remedy over the muscle. But, as will be shown directly, electricity may sometimes be used with great effect in the cure of certain chronic cases of inflammation; and thus, in cases of palsy dependent on chronic inflammatory thickening of the supplying nerve, a cure may be hoped for by the antiphlogistic power of the agent directed to the diseased part of the nerve.

In all cases of palsy arising from simple debility or depression of the centres, and all those of local origin, not dependent on irreparable loss of parts, or other organic injury, much good may be hoped for from electricity.

In relation to the precise circumstances under which, in the cases above mentioned as indicating this agent, it may be used with the greatest benefit, to the precise modes, moreover, in which it may be most effectually employed, and the probable results in each case, nothing has appeared which, so far as I am able to judge, approaches in value the recent contributions of M. Duchenne to this branch of therapeutics. In the following remarks on the use of the remedy in palsy, the reader will please to ascribe to that author most of the credit of what he may find in them that is meritorious.

In the first place, it may be stated, as a general rule, that application directly to the palsied part is much more efficacious than when made through the medium of the nerve supplying the part.

In palsy, the sensibility and power of motion may both be lost, or either, without the other.

In reference to the condition of the muscles, palsies may be classified according to the mode in which the part affected is influenced by the electric current; and, by attention to these differences, great assistance is gained, not only in diagnosis, but in the proper application of the remedy. There are two classes of the affection; one in which the muscle does not contract, or contracts but slightly and inefficiently, under the electric stimulus, and the other in which it responds readily to the stimulus, and contracts whenever it is applied. In one case the electro-contractility is lost or impaired, in the other it remains untouched. To the former class belong *palsies depending on lesions, traumatic or otherwise, of the spinal marrow or nervous trunks proceeding from it*, and the *palsy of lead*; to the latter all the *purely cerebral palsies*, whether proceeding from hemorrhage, inflammation, or other lesion, the *palsies denominated rheumatic and hysterical*, and those *dependent on atrophy or fatty degeneration of the muscle itself*, which exhibits this property so long as any of the muscular fibre is left. The electro-sensibility, or susceptibility to painful impression from electricity, is somewhat differently modified. Generally speaking, a loss or diminution of electro-contractility is accompanied with the same condition of electro-sensibility; but with integrity of the electro-contractility, the sensibility may be normal, increased, diminished, or quite lost. Having made these preliminary observations, we will proceed to the consideration of the special palsies. The reader will remember that it is the electricity of induction, the form, namely, developed by the magneto-galvanic or magneto-electric machines, that is employed, unless the fact is otherwise specially stated. We may sometimes use M. Duchenne's term of *faradisation*, to signify this mode of applying electricity.

1. *Palsy from Cerebral Hemorrhage.* This generally assumes the form of *hemiplegia*; but it may also be *paraplegic* or *local*. The reader will bear in mind the observations above made, in relation to the circumstances under which electricity becomes applicable in this affection. No attempt should be made to employ this agent, until there is reason to think that the effused blood has been absorbed, and a cyst or cicatrix only remains, without inflammatory action. It will seldom be proper to begin with the use of it until six or seven months after the commencement of the disease. If employed too early, there will be great danger of producing hazardous congestion or inflammation of the brain, through the reaction upon it of the local disturbance. To obviate this as far as possible, the excitors should be placed as near each other as may consist with the object of sending the current into the muscle, so as to confine the disturbance within the narrowest limits. If, in cases of cerebral hemorrhage, after from five to eight months, the palsy persists without any contraction of the muscles, a cure may be expected with considerable certainty under faradisation; if there be permanent

contraction, little hope of a cure need be indulged; as this condition indicates a persistent state of cerebral inflammation or softening, which is not likely to cease.* If there be only temporary, or irregular contractions, the prognosis is less favourable than with none, but not altogether unfavourable: as this condition may be owing to an unhealthy excitability of the spinal centres, consequent on a diminution of cerebral power. Nor must the mere stiffening of a muscle, arising from its

---

* Dr. Robert Remak, of Berlin, asserts, as the result of numerous trials, that the application of the continued current, as produced by the elements of Daniell, Grove, and Bunsen, has the effect of immediately relaxing the tonic spasms of the muscles attending hemiplegia from cerebral hemorrhage, and rendering them amenable to the action of the will. He affirms, too, that by the continued application of the constant current to the nerves and muscles, he has obtained curative effects greater than he had been able to obtain by any other mode of applying electricity, in acute and chronic rheumatism, cerebral hemiplegia, paraplegia, muscular atrophy, chorea, stammering, trembling of the limbs, and cramps. (*Med. Times and Gaz.*, May, 1858, p. 479.)—*Note to the second edition.*

The late Berlin Professor, Dr. Robert Remak, referred to in the preceding note, was one of the highest German authorities on the subject of medical electricity, and the great advocate for *galvanization*, or the use of the *constant current* as a therapeutic agent, in contradistinction to the *induced* or *interrupted current*, the *faradisation* of M. Duchenne. Shortly before his decease, he delivered a course of lectures at the Hospital "*La Charité*," of Paris, setting forth his peculiar views, a translation of which is published in the *New York Medical Journal* for June, July, and August, 1866 (pp. 185, 279, and 357). The following are some of the more interesting points, which I have thought it due to the subject of electrical therapeutics to place before the readers of this work. The constant galvanic current is, according to Prof. Remak, incomparably superior, in the treatment of diseases, to all other electrical currents; and, in the majority of instances where this is useful, the induction currents are rather injurious than otherwise. He appears to prefer, for the development of galvanism, the battery of Daniell, which affords a more constant current than that either of Grove or of Bunsen, and the objection to which, of requiring daily cleansing, has been obviated by recent improvements. He applies the current to the surface by means of metallic electrodes covered with muslin or wool, moistened with water, which communicate with the conducting rods by a bundle of silver wires, with gutta percha or caoutchouc envelopes (p. 188). He prefers the surface of application of those instruments to be as broad as circumstances will admit; but it of course must vary in size according to the part to which it is applied.

The general effect of a prolonged application of the constant current is increase of the temperature of the body, followed by perspiration, and often a long sleep and subsequent general feeling of repose. Of the local effects the most curious are those upon the special senses, which are not produced by the induction current. Thus, a very feeble current applied to the face occasions flashes of light, and a peculiar modification of taste. Though, in a healthy state of the organ of hearing, little effect is produced; yet, in nervous deafness, the gentlest application of the current to the petrous bone causes sounds. The retina is most sensitive to the positive pole, the gustatory nerves to the negative; and the auditory nerve is more sensitive at the opening of the circuit than at its close. Another effect of the constant current is a species of vertigo, which is apt to happen when the application is made to a certain limited space, as in the auriculo-maxillary fossa. A descending current acts more energetically on the nerves of sensation, an ascending on those of motion; the former at the point of exit, the latter at that of entrance.

The two electrodes act differently on the blood-vessels: the positive dilating them and reddening the skin, the negative producing a contrary effect, after continuing from five to ten minutes in action.

Dr Remak makes a distinction between the *constant* and the *continuous* currents. The voltaic pile may give a continuous current, but it is not steady, and gradually weakens until it ceases at last: the constant current continues long without losing its intensity. The constant current does not require that the electrodes should be in immovable contact with the skin: but is developed equally by passing the electrodes over the surface from point to point, without separating them from the body. These currents are distinguished as the *current in repose* and the *current in motion*, the former proceeding from the unmoved electrode, the latter from the one changing its position. As to the visible effects of the electrodes on the skin, the negative pole rather than the positive, produces a papillary and urticarious eruption, often extremely sensitive, and, after prolonged application, becoming filled with fluid, and ending at length in a brown crust.

In general the current in repose is calming, and the current in motion exciting; yet, in severe paralysis, the former, when not too much prolonged, is more energetic in restoring power than the latter. Generally, interruptions in the constant current weaken it, and are useful only in the treatment of contracted muscles. The soothing influence of the constant current is exerted by very feeble galvanic action, insufficient even to disturb the skin. It differs from the sedative influence of the narcotics, as opium, belladonna, etc., and should not supersede them; but when these fail to yield prompt relief, and in cases requiring their long-continued use, galvanization should be resorted to, which both soothes and stimulates. The soothing influence may be employed to relieve exaggerated sensibility in a part, the result of inflammation. Under such circumstances, the positive electrode may be applied over the painful part, the negative at a distance. A battery of from 15 to 25 elements will generally give relief in from 5 to 20 minutes. But the most effective plan, which relieves the severest inflammation and most exquisite sensitiveness, is to place the positive electrode on some point of the nerve-trunk which is distributed to the diseased part, and the negative anywhere else.

Dr. Remak mentions as a curious fact, that, in the treatment of neuralgia, the direct application of the constant current to certain points of the nerve-centres having no relation with the limb or part affected, is often very effectual. This, however, may be considered as an example of revulsion, analogous to the powerful influence of mental emotion in relieving neuralgia.

The constant current is radically curative only where it reaches the source of the disease; for example, when it acts on and removes the inflammatory swelling of the nervous sheath, on which neuralgia may depend.

In the treatment of paralysis, whether of motion or sensation, the galvanic current will exhibit its anti-paralytic power only when any disease in the nervous centres or trunks in which the paralysis originated has ceased. Then the constant current, sent through the negative electrode, to the nervous filaments supplying the paralysed muscle, will instantly render the muscle subservient to the will. But to effect a perfect cure, it will be necessary to apply the current several times, shortening by position, be confounded with tonic spasm or rigidity. M. Duchenne effected radical cures in one-twentieth only of the cases, and amelioration in about one-quarter. The probability, I think, is that the electricity does not operate altogether locally, in these cases, in restoring voluntary contractility; but that the excitement produced in the muscle, also reacts usefully as a stimulant upon the cerebral centres.

It may sometimes be very important, in deciding as to the proper period for commencing with the electric treatment, to know certainly whether the affection is really cerebral. The complete integrity of the electro-muscular contractility in the paralyzed muscle, which characterizes the cerebral cases, might be sufficient sometimes to determine the question.

When palsy of the face and tongue only is left after the absorption of the effused blood, it will in general readily yield to this remedy; but it should be employed, at first, with much caution, for fear of involving the brain, from its vicinity.

Indeed, it would be a good rule, in reference to cerebral palsy in general, to commence cautiously, with short sittings of not more than five minutes, and not repeated oftener than every second or third day, until the state of the brain shall have been sufficiently tested. The intermissions, too, should be distant, as exciting less disturbance of sensation, which is most to be apprehended; while the contraction produced is energetic. The influence should be directed to every paralyzed muscle; and those most deeply affected should be longest and most strongly excited.

2. *Palsy of the Insane.* This form of palsy is scarcely a proper subject, under any circumstances, for the application of electricity, which is

---

so as to reach all the fibres, of which some may have at first escaped its influence. Whenever the palsy depends on tumefaction of the nerve sheaths, whether proceeding from inflammation of the bones, joints, or viscera, or from injury to the nerve itself, as by cold, violent stretching, etc., the indication is to bring the constant current to bear on the swollen nerve; and the lost contractility will in time be restored, even in the most inveterate cases. Not only paralysis from this source, but morbid contractions of the muscles, and even hyperæsthesia, which may have a similar origin, will yield to the same measure. These affections are very apt to occur in the lower extremities, and especially in the regions of the crural and sciatic nerves; and the most obstinate forms of sciatica sometimes have their origin in this cause.

I have not space for the further observations of Dr. Remak; and this is of the less importance, as they are so mingled with hypothetical views, and presented in so fragmentary a form, as very much to lessen their value; but in what precedes I have endeavoured to do justice to the claims he puts forth for galvanization as distinguished from faradisation as a therapeutic agent, which, in the statements made in the text, might perhaps be considered as somewhat undervalued. (*Note to the third edition.*)

contraindicated by the existing and increasing cerebral lesion. It may, however, sometimes be important not to mistake for it some other form of palsy which may be benefited by this agent. The fact that this variety is always attended with unimpaired electro-muscular contractility may sometimes serve to distinguish it from cases of general palsy, of another origin, in which this property may be wanting, and which may be amenable in some degree to the remedy.

3. *Spinal Palsy.* This has most frequently the form of *paraplegia.* When dependent on active congestion, inflammation, or even pressure from moderate hemorrhage or effusion, it often, I believe, ends favourably with the removal of the disease in the spinal column; and, in such cases, there is no indication whatever for electricity, which could be productive only of mischief. When the palsy, having originated in an injury or wound of the spine, persists after time has been allowed for the repair of the injury, the remedy may be used with hope of benefit. But as this case falls under the category of traumatic paralysis, of which I shall treat separately, it is unnecessary to say more of it at present. When the palsy continues in consequence of previous hemorrhage, the same prognosis and indications exist as in cerebral hemorrhage. But, unhappily, most cases of obstinate spinal paraplegia depend on spontaneous organic lesion of the medulla, generally of inflammatory origin; and little is to be expected from any remedy. Electricity should be used only when the palsy has survived all traces of spinal inflammation, under which circumstances it is indicated, and will no doubt often do good. I presume that most of the cases of paraplegia, not hysterical, which end in recovery under the use of electricity and nux vomica, are of this character. In spinal paralysis, according to M. Duchenne, there is a complete absence of electro-muscular contractility and sensibility. I should say that there might be good reason to refer the disease to the spine when this condition is presented; but it does not necessarily follow, because sensation and voluntary motion are lost in the lower extremities, in consequence of disease in the spinal marrow, that therefore reflex action should cease; for the lesion may be seated only in the conducting fibres by which the brain communicates with the limbs, and the spinal centres themselves may be untouched. Such, I believe, are the many cases of paraplegia which M. Duchenne is indisposed to consider spinal, because wanting in what he deems to be the characteristic relation to electric influence, and which are benefited by faradisation.

4. *Traumatic Palsy.* This is one of the forms of palsy in which electricity exercises the most extraordinary powers. It is applicable, of course, only after the wound or injury of the nerve has healed, or been repaired; but, after this event, there is occasionally left behind a very paralytic condition, which shows no disposition to recovery, and may go on indefinitely, unless relieved. Scarcely any length of time offers an

obstacle, in these cases, to the beneficial effects of electricity, unless the injury has been such as in its nature to be irremediable, or the muscle has undergone complete degeneration from want of use. Cases have been cured after a duration of four years. The application should be made every other day, and eight or ten minutes at a time. The muscles are often much atrophied, and, as before stated, electro-muscular contractility and sensibility have been lost. The first step towards recovery is usually the excitation of painful sensation, with heat in the part. After this follows an obvious improvement in the nutrition of the muscle; the power of voluntary movement next returns; and all this may occur before the electro-muscular contractility has been restored. At length, however, the muscle contracts under the electric excitement, and the cure is completed. If electric contractility should not have been wholly abolished, it is unnecessary to delay the use of the remedy; but otherwise it would be best to wait for the complete repair of the injury, even so long as from four to ten months. Each muscle should be treated according to its condition. The more it is atrophied, and the less is its contractility, the more intense should be the current, and the more rapid the intermissions. The duration of each sitting should be ten or fifteen minutes at furthest; and rarely more than one minute should be given to each muscle. The operation should also pass rapidly from muscle to muscle, returning several times to each, in order to prevent too great fatigue to any one. Cures may be effected in the majority of cases. The mean duration of treatment is two or three months; but sometimes years are required before a complete cure can be effected.

5. *Rheumatic Palsy.* This name has been given to a variety of palsy which comes on after exposure to cold. It is sometimes preceded by pain, which disappears, leaving the palsy behind; sometimes is wholly unattended with pain. It may occur in any part of the body, but is most common in the forearm and shoulder. Sometimes it affects the face through the seventh pair of nerves, and sometimes also probably appears in the form of paraplegia; in which case I have no doubt the seat of the rheumatic disease is in the spine. It is often a serious affection; the muscles becoming atrophied, and sometimes contracted so as to produce a good deal of deformity. It is distinguished from lead-palsy by the unimpaired electro-muscular contractility and sensibility. In the face, it may sometimes be difficult to determine between it and cerebral palsy; but independently of the facts that, in the latter case, there are generally obvious head symptoms, and palsy elsewhere, there is one diagnostic character worthy of attention. In hemiplegia we seldom meet with palsy of the orbicular muscle of the eyelid, and the inference is probable that, when cerebral palsy is confined to the face, this phenomenon will be wanting. When it occurs, therefore, in facial paralysis, the affection may be considered as probably seated in the seventh pair.

Correct diagnosis is here very important; as, if the affection be cerebral, electricity is contraindicated for a long time after the attack; whereas, if it be mere rheumatic palsy of the seventh pair, the remedy may be applied speedily. Rheumatic palsy may almost always be cured by faradisation. The natural tonic contractility is often restored, thereby removing deformity, before the muscles come under the control of the will. The muscles sometimes assume their proper symmetry three or four weeks before a single voluntary movement has been made by them. In the affection of the seventh pair, which is not unfrequently attended with an unsightly distortion of the features, it is important to examine each muscle carefully, and give it the due share of electrical excitation.

6. *Hysterical Palsy.* When palsy attacks hysterical women, and can be referred to no precise origin, it is considered usually as entitled to this designation. It is characterized by retaining the electro-muscular contractility, but is generally attended with diminished sensibility of the muscle. It will generally yield to electricity; though, in some rare instances, it resists this, as all other remedies. Under such circumstances, however, it is probably something more than merely hysterical. The faradisation should be applied to every organ affected, and the application continued for some time after recovery. In consequence of the great nervous excitability of the patient, it is best to commence very lightly, spending the first sitting in doing little more than accustoming the patient to the manipulations; and gradually increasing as she is found to tolerate the remedy. The diminished sensibility of the muscles renders rapid intermissions of the current necessary; but watchfulness must be observed, lest a little too much local disturbance should bring on an attack of hysteria. The remedy should be directed as well to the nervous trunk as to the parts affected. Sometimes it may be sufficient to stimulate the cutaneous sensibility; but this is more painful, and will not often be submitted to.

7. *Diphtheric Palsy.* For a minute description of the palsy so apt to follow attacks of diphtheria, to which the attention of the profession has been especially called only of late, the reader is referred to my *Treatise on the Practice of Medicine* (6th ed., ii. 514). In mentioning it here, my object is to state that, in the cases which have been examined in reference to the electric condition of the muscles, they were found to possess sensibility to the galvanic influence; and that electricity is one of the remedies to which, with suitable adjuvant measures, the disease has yielded most readily. It is probable that faradisation in this, as in the rheumatic variety of the disease, is the form in which the remedy will prove most effective.

8. *Lead Palsy.* If the muscles retain only a small portion of their electric contractility, it may be considered certain that the disease will recover easily and rapidly; and even with a complete loss of that prop-

erty, a favourable result may be expected, though it will be longer postponed. When, with the loss of the contractility, there is at the same time a great diminution of sensibility, with atrophy conjoined, the cure is still more difficult and protracted. But the remedy will almost always succeed in the end. From thirty to one hundred sittings may be required, at the rate of three weekly; but, by operating at shorter intervals, the length of time required may be diminished. An intense current with rapid intermissions should be used. It is desirable to excite painful sensations; and, as these are attended sometimes with considerable constitutional disturbance, it is impossible, in many instances, to have quickly repeated sittings. Hence the length of time often required for the cure.

9. *Progressive Fatty Muscular Atrophy.* Under this name M. Duchenne refers to a disease long known as a variety of *general palsy*, but which has only recently become well understood. It consists essentially in a gradually progressive atrophy of the muscles, with fatty degeneration of the fibres; and the paralytic phenomena are ascribable to the organic change in the muscle. The credit of first ascertaining its true nature appears to be due to M. Cruveilhier, who demonstrated the existence of fatty degeneration of the affected tissue. It is distinguished from all other forms of palsy, by the irregular and apparently capricious method in which the muscles are struck with the disease; so that in the vicinity of a round plump muscle, is a cavity consequent upon the atrophy of another, thus giving a quite characteristic aspect to the complaint. The only other pathological lesion found, is a wasting or atrophy of the anterior roots of the corresponding spinal nerves, which has been noticed in one or more cases. The spinal marrow is quite sound; and it is uncertain whether the nervous atrophy noticed was a result or cause of the affection. A singular fact in relation to the disease is, that the muscles retain their electric contractility, or contract under electric excitement, as long as any of the fibres remain undestroyed. It was generally considered quite incurable; but M. Duchenne has demonstrated that it may at least be arrested in its course by means of faradisation; and has even rendered it probable that the muscle may recover its normal structure, if it shall not have been so far destroyed, before the commencement of treatment, as to give no sign of contraction when electrically excited. At least muscles which have been apparently wasted away almost to nothing recover their healthful size, and their power of action. It is said that the atrophy precedes the fatty degeneration; and it may be supposed that the shrinking is only in consequence of the absorption of the inter-fibrous matter; but M. Duchenne thinks that new fibres are created; and, if so, there is no reason why the muscle might not grow after partial destruction from fatty degeneration, as well as from any other cause. The treatment of the affection generally requires an apparatus of

great force and rapid intermissions: and a feeble instrument may fail altogether. Each application, however, should not continue longer than eight or ten minutes, for fear of exhausting the muscle, and thus hastening its destruction. The sensibility of the muscles, which is at first blunted, in general rapidly increases, and it is necessary gradually to diminish the energy of the treatment: but it should be sustained at the highest point possible.

A similar affection is sometimes met with in infancy, and may be treated in the same way.

10. *Paralysis of the Bladder.—Dysury.—Incontinence.* Difficulty in evacuating the bladder sometimes proceeds from palsy or debility of the abdominal muscles; the urine being forcibly expelled if a catheter is introduced. In such cases, the affection will generally yield promptly to faradisation of those muscles. In proper palsy of the muscular coat of the bladder, the electricity may be applied in the manner already described (see *page* 518), either by excitors introduced into the rectum and bladder, or into the bladder alone, or one into the bladder, and the other moistened and moved over the hypogastric region externally. Sometimes there is loss of sensibility in the mucous coat of the bladder; so that the urine accumulates because the patient is unconscious of its presence. All that is requisite for its evacuation is the exercise of the will. Here it is advisable to make the application directly to the internal coat.

In *incontinence* depending on paralysis of the sphincter or neck of the bladder, one excitor should be introduced into the rectum, and moved over the parts corresponding with the levator ani, while the metallic extremity of the other is brought, through the urethra, into apposition with the neck of the bladder.

11. *Impotence* may sometimes be usefully treated with electricity in this manner, applied to the organs of generation externally, and to the vesiculæ seminales through the rectum or urethra.

12. *Paralysis of the Rectum, and of the Sphincter Ani.* Palsy of the rectum, which is indicated sometimes by an obstinate constipation, may often be relieved by faradising the rectum directly, in the manner before described. (See *page* 518.)

In *prolapsus ani*, which is generally, when considerable, connected with relaxation of the sphincters of the anus, and in *incontinence of the feces* dependent on the same cause, one excitor may be introduced into the anus, and the other, in the form of a wet sponge, applied externally to the perinæum. The operation may be continued eight or ten minutes. Obstinate cases of prolapsus in children have been promptly cured by this treatment.

13. *Palsy of the Larynx.—Aphonia.* When not dependent on organic lesion, or symptomatic of some other disease, this will sometimes yield

to local faradisation applied to the muscles from without, and the skin also, or by operating through the pharynx. (See *page* 519.) The loss of the strength and character of the voice, often incurred by those who speak much in public, may be relieved by the same measure. Other modes of applying the remedy, as by successive discharges through the organ from a powerful battery, by a galvanic current introduced by means of acupuncture, and by the simple apparatus of a small zinc and silver plate (see *page* 504), one on one side, the other on the other of the larynx, have also proved successful. But in these cases electricity, like all other measures, not unfrequently fails without any assignable cause.

14. *Cutaneous Anæsthesia, or Loss of Sensibility in the Skin.* The loss of sensibility in paralytic muscles is generally remedied at the same time with loss of motion. But sometimes the two conditions exist separately; and insensibility of the skin is not a very uncommon affection. In this isolated state, when not dependent on organic lesion of the nerves, it is generally an hysterical affection, and yields readily to the electrical influence. When it affects the face, the best method of applying the remedy is by the hand, which usually proves sufficient for the cure. If not, the blunt excitors may be applied, and these will often answer for other parts of the body. But sometimes a more energetic impression is required for the general surface, which may be obtained by means of "fustigation" with the brush of wires. (See *page* 508.) The excitors should generally be carried from one point to another of the surface, until the whole affected part has been electrified. Sometimes, however, the insensibility is so great that it is necessary to leave the bunch of wires for some time in contact, until sensation is produced. First a tingling is felt, then a burning sensation, and this soon increases so that it can be borne no longer. As the skin becomes more sensitive, it is necessary to return to the blunt excitors again In a few instances the return of sensibility, in a small space, is followed, without further application, by its extension over the whole part affected; but much more frequently it is necessary that every part should be subjected to the contact of the instruments. Sometimes the affection returns after having yielded, but may be cured by repetitions of the application. It is in the hands and soles of the feet, that the inconvenience of this paralytic condition is greatest, and the cure of it most important.

15. *Amaurosis.* Electricity should never be employed in this affection, if there be any reason to suppose that it depends on active congestion, inflammation, or other organic disease in the nervous centre of vision, the nerve itself, or its expansion on the retina. In purely functional cases, it may sometimes be used with benefit; but galvanism is here more effective than the induced electricity. In doubtful cases, it may be applied over the face and about the orbit in the first place, in order to

excite the eye through the ramifications of the fifth pair, which have a peculiar influence over vision when galvanically excited; and, if this measure is unsuccessful, the application may be made to the ball of the eye, in order directly to excite the optic nerve; one pole being placed in the orbit, and the other at the back of the neck. Acupuncture of the parts about the eye has been brought to the aid of galvanism; and many cures of incomplete, and some of complete amaurosis have been reported, supposed to have been obtained in this way. (See Channing, *Medical Application of Electricity*, Boston, 1852, p. 87.) The electro-magnetic instrument with two wires may also be used for this purpose, though less effective than the battery.

16. *Deafness.* In nervous deafness, faradisation of the *chorda tympani* has been followed by happy results. Great care must be exercised in conducting this operation. While the patient lies on his side, the meatus auditorius should be *half* filled with water; a wire connected with one of the poles should then be introduced so as to touch neither the tympanum nor the walls of the passage; and the wet sponge excitor, connected with the other pole, should then be applied to the nape of the neck. The slightest power of the instrument should be first exerted; not greater than may be sufficient to cause the least possible sensation when the excitors are applied to the end of the tongue; and then increased as may be found necessary. A slight buzzing sound is first produced by this operation in the ear when healthful, followed by tingling, and then, with the increase of the force of the current, by severe pain; the tingling, with a sense of numbness, extending to the side and anterior part of the tongue. There is also a peculiar taste produced. M. Duchenne has seen this process cure, in a short time, cases of deafness which had long resisted energetic measures, under the most competent practitioners. It is not impossible that the same measure might be useful in deafness of organic origin, provided all acuteness of symptoms had passed. The functional disorders of hearing which are so common, and so frequently alluded to by writers under the name of *tinnitus aurium*, often yield with the utmost facility to the remedy. It is asserted that galvanism has proved useful by promoting the absorption of pus and coagulable lymph in the cavity of the tympanum, and in exciting the secretion of wax when deficient.

17. *Smell and Taste.* In paralytic conditions of these functions, as well as in palsy of the muscles of the tongue, the application of electricity may be made in the manner stated in *page* 520.

Stammering, which may possibly sometimes be connected with debility of the muscles of the tongue, and other parts concerned in articulation, is said to have been benefited by a galvanic current directed from the tongue to the surface of the throat.

2. *General and Local Relaxation, Debility, or Torpor.*

Under this head may be enumerated a considerable number of affections in which electricity has been found more or less useful.

In *asphyxia* and *syncope* it may be resorted to in reference to the shock upon the system, and, in the former, to promote contraction of the diaphragm. In *asphyxia*, or a state approaching it, arising *from narcotic poisoning*, especially that from opium, it has been employed, with striking success, in several cases, among which may be mentioned one recorded by Dr. Page, of Valparaiso, and a second by Dr. James Russel, of London. Electro-magnetism was used in both these cases, the direction being, in one case, from one side to the other through the heart; in the other, from the back of the neck to the sternum, by which respiration was restored. In *asphyxia from drowning*, a current of galvanism has been passed into the diaphragm, by cutting down to the muscle below the seventh rib, with the apparent effect of saving life. Acupuncture would probably have answered the same purpose. In these cases of asphyxia and syncope, it is probable that the mere shock upon the nervous centres, occasioned by pain, has great influence in rousing the patient; and, for the production of this effect, nothing is more powerful, prompt, and safe than the electro-magnetic current with rapid intermissions.*

Artificial respiration, when desirable, may be most conveniently produced, according to M. Duchenne, by calling the diaphragm into action, through a vigorous impression on the phrenic nerve, where it passes the anterior scalenus muscle. This nerve, after the union of its three roots, descends from without inwardly before the anterior surface of the scalenus. It is at this point that it is necessary to make the requisite application. Some difficulty is thrown in the way by the sterno-mastoid and platysma-myoid muscles, which cover the scalenus. But by depressing the skin from without inwards, with two fingers placed along the outer border of the clavicular fasciculus of the sterno-mastoid, then separating the fingers, and maintaining the pressure, access may be obtained to the anterior surface of the scalenus, without the interposition of the other muscles. One of the excitors is to be placed between the fingers, in such a manner as to cross the direction of the phrenic nerve. While an assistant holds the instrument in this position, the second excitor is to be similarly applied on the opposite side. Then the operator takes hold of both by their isolated handles, and the machine is set in motion. Any of the inductive machines will answer the purpose, if properly graduated, and of very rapid intermissions. The excitors should end in a small metallic cone, which should be covered with moist leather. The instant that the current is passed, the lower ribs expand, the abdominal walls rise, and air rushes with sound into the lungs. After a second or two, the current is broken, the walls of the chest subside, and expiration takes place. To complete the expiration, an assistant presses upon the chest and abdomen. In another second, the operation is resumed; and this artificial respiration, perfectly imitating the natural, may be kept up as long as may be necessary. (*Electrisation Localisée*, pp. 485–6)

---

* A remarkable case of resuscitation after drowning, by means of the induction apparatus, and electro-acupuncture, by Dr. A. C. Garratt, of Boston, is recorded in the *Boston Med. and Surg. Journ.* (Sept. 5, 1861, p. 89). It is well worth perusal, as an example of success rewarding faithful and long-continued effort, under apparently the most discouraging circumstances. (*Note to the third edition.*)

In poisoning from opium and other narcotics, even when threatening symptoms of asphyxia have not yet appeared, the painful excitation of the electro-magnetic machine is useful, independently of its influence on respiration, by stimulating the nervous centres, and sustaining life until the action of the poison has passed. A case of this kind has been reported by Dr. Bullock, of Wilmington, Delaware. (*Am. Journ. of Med. Sci.*, N. S., xxviii. 575.)

In *general muscular relaxation*, the excitant influence of electricity may perhaps sometimes be usefully employed, by rapidly faradising the different muscles successively.

In debility of various functions it has been used with supposed, and no doubt often with real benefit.

In *dyspepsia*, a current of galvanism may be passed from the nape of the neck to the epigastrium, or immediately through the stomach, from before backward.

Torpid liver may be treated in the same way, the current being sent in various directions through the organ, so as to traverse the whole of it as far as possible.

Suppression of the secretion of milk is said to yield frequently to faradisation of the mamma, sometimes after three or four daily applications of the remedy. It should not be carried so far as to occasion contraction of the pectoral muscles, or severe pain. Each operation may continue fifteen or twenty minutes. The induced current is here the most effective.

Constipation dependent on inertia of the bowels has often been treated advantageously with electricity. Allusion has already been made, under palsy of the rectum, to the mode of treating it when arising from that cause. In other cases, the current may be made to pass from the fundament, or from an excitor introduced into the rectum, to the pit of the stomach, or to various points over the surface of the abdomen; or it may be directed through the bowels from before backward, or from side to side.

Amenorrhœa has been treated by electricity with great success. Dr. Golding Bird states that he has never known it to fail in exciting menstruation, when the uterus was capable of performing that function. (*Lond. Med. Gaz.*, June, 1847.) After proper attention to the general health, a dozen shocks of the Leyden jar were passed through the organ, from the sacrum to the pubes, and the measure was repeated daily, if necessary.

Flooding after delivery is said to have been effectually controlled by galvanism, which produces contraction of the uterus. Dr. Radford, who has employed the remedy for this purpose, states that it may be so applied as to excite not only tonic, but also intermittent contraction, and suggests it as a means of hastening tedious labours. He used a coil machine, applying one pole to the os uteri, and the other to the walls of the abdomen over the fundus. The conductor introduced into the vagina must be covered with a non-conducting material, except at its extremity. (*Prov. Med. Journ.*, Dec. 1844.) Dr. F. W. Mackenzie has found a sustained galvanic current, sent through the uterus longitudinally from the upper portion of the spinal cord, to be very useful in promoting contraction of the uterus in hemorrhage with threatened abortion, and, in cases of placenta prævia, in facilitating delivery and preventing hemorrhage. (*Med. Times and Gaz*, March, 1858, p. 271.)

In a *cool, dry, inactive state of the skin*, especially when connected with interior disease, much benefit may be expected from electric stimulation of the surface, which is accomplished, in the mildest method, by withdrawing sparks from the body in the electrical bath; in the severest, through the agency of the electro-magnetic machine, and M. Duchenne's wire excitor; and, in intermediate grades, by the different arrangements at command. Indeed, electricity, in its various forms and modes of application, affords to a practitioner, suitably provided with apparatus, a powerful method of revulsion to the surface, of which he may avail himself in a great number of diseased conditions.

Indolent ulcers may be stimulated into a healing condition by making their surfaces the recipient of the galvanic current, either through the moist sponge excitor, or their own wet dressings connected with one of the poles, or by covering them with a plate of silver or copper forming one of the constituents of a galvanic arrangement, of which a zinc plate, applied to another portion of the surface, and connected with it by a wire, may form another.

Opacity of the cornea may, according to Dr. Althaus, be generally cured by faradisation, which is greatly preferable to ordinary galvanism for this purpose, because so much less likely to disturb the retina. The negative pole should be applied over the closed eye, and the positive held in the hand of the patient. The application may continue fifteen minutes, and be repeated every other day. A cure may be expected in from one to three months. (*Med. T. and Gaz.*, Sept. 1862, p. 271.)

In the *photophobia of scrofulous ophthalmia* in children, extraordinary success has been obtained by Dr. Addinell Hewson, of Philadelphia, from the ordinary galvanic current, applied over the supra-orbital branch of the fifth nerve. He made use of Pulvermacher's chain battery of sixty links, using vinegar as the exciting agent. The applications were usually made every three or four days, and for a minute or two each time; but they might be repeated daily without disadvantage. Great relief followed the first application, and a cure was in general effected. (*Am. J. of Med. Sci.*, Jan. 1860, p. 114.)

3. *Neuralgic and Rheumatic Affections.*

Neuralgia. Electricity has been found curative in many cases of this affection, operating, it would seem, sometimes directly by the benumbing influence of its excessive power, sometimes revulsively. These two methods require different applications of the electric influence. If the object be to operate revulsively, the plan of Duchenne may be followed of confining the action to the skin (see *page* 517); if to benumb the nerve, a moistened extremity of one conductor should be applied over the nervous trunk as far up as may be, the other over one or more of its branches in which the pain may be felt.

Excessive cutaneous sensibility, which is a frequent attendant upon hysteria, yields in general readily to faradisation. The treatment is applicable only to purely functional cases, and not to those dependent on lesions of the nerves or their centres. In the application of the remedy, the skin should be kept perfectly dry. Sometimes fustigation may be used; in other cases, the blunt excitors, carried from point to point over the sensitive part, will be sufficient. The instrument should work with rapid intermissions, and with an intensity as great as the patient can well bear; and the operation may be continued from two to five minutes. A feeling of numbness follows the first pain, with an agreeable sense of relief. Sometimes a single sitting is sufficient; but more frequently the complaint returns after some hours, though with diminished intensity; and several applications are required before the cure is effected. In many cases, however, only temporary relief is obtained.

A similar excessive sensibility of the muscles sometimes occurs, which may either be conjoined with the cutaneous affection, or may coexist with insensibility of the skin. Though usually more resistant than the pure cutaneous affection, it often yields promptly to a similar excitation of the surface.

In neuralgia of the face, tongue, etc., galvanism and electro-magnetism have both been used with occasional success; the former being sometimes aided by acupuncture; but the general result has not been very encouraging.

Sciatica is an extremely obstinate form of disease, sometimes apparently purely neuralgic, sometimes rheumatic, and in other cases attended with inflammation of the neurilemma. When purely functional, it will sometimes yield to faradisation, after vain attempts to cure it by other means. Occasionally it will give way, for a time, to a sudden and violent pain excited by fustigation, or the contact of the wires, in any part of the surface. The measure, however, is more effectual when put in operation in the vicinity of the part. The skin must be thoroughly dried, so as to prevent the current from penetrating to the nerve, in which case the pain is aggravated. The relief at first procured is temporary; but, by repeating the fustigation upon each return, or at relatively short intervals, for six or eight times, the disease will often yield entirely. The most obstinate cases in the hospitals have recovered under the remedy. Electro-puncture is asserted also to have been used with advantage; but the cutaneous excitation is preferable.

Angina pectoris, in one striking instance under the care of M. Duchenne, yielded speedily to *electro-cutaneous excitation* applied to the mammary region. At the moment of the application of the two metallic excitors, which proceeded from a powerful machine graduated to the maximum, and working with rapid intermissions, the patient uttered a loud cry, so as to render it necessary to interrupt the operation; but the pain of the angina, which had been excessive, ceased at once. By repeating the operation at each return, the disease appeared to yield entirely.

In other *neuralgic cases*, whether external or in the viscera, the remedy has operated with equal success. It should be recollected that it is the cutaneous excitement that is produced here; the current being prevented from penetrating beneath the skin by drying it thoroughly with some absorbent powder.

In *colica pictonum*, M. Briquet effects prompt relief by faradisation of the surface of the abdomen. For an account of his mode of applying the remedy see my *Treatise on the Practice of Medicine* (6th ed., vol. i. p. 748).

Rheumatism. In the neuralgic form, this complaint will often yield with great facility to the electric influence; and it is probable that many of the cases treated successfully under the names of neuralgia, sciatica, angina pectoris, etc., have been either of this character, or gouty. But ordinary muscular subacute rheumatism, such as lumbago, pleurodynia, torticollis, etc., will also frequently yield to the remedy as to a charm. Sometimes a single *faradisation of the skin* is sufficient to effect a cure; but more frequently the pain returns, and five or six applications may be necessary for the purpose. It should not be abandoned until the last vestige of pain has been removed. *Rheumatic arthralgia* will also often yield happily to the remedy. To *acute inflammatory rheumatism* it is wholly inapplicable. In *chronic rheumatism of the joints*, galvanism, with the aid of acupuncture, has sometimes proved efficient; but electro-magnetism would probably be safer, as less likely to excite inflammation, with an equal degree of power.

Rheumatic contraction of the muscles, which not unfrequently affects the face, neck, shoulder, and parts of the chest, and which has a very disagreeable distorting effect, will generally yield to this remedy applied to the skin. M. Duchenne also cures the affection by bringing the antagonistic muscles into play through the electric current, and thus establishing an equilibrium between them.

4. *Spasmodic Affections.*

Many of these complaints have been treated by electricity, with variable success, as *hysteria, epilepsy, chorea,* etc., and Matteucci even ventured to recommend it in *tetanus,* on the ground that a continuance of the electric current exhausts after a time the excitability of the muscles; but experience has not yet pronounced in its favour. In *spasmodic asthma* great relief is said to have been sometimes obtained by passing a current of galvanism from the nape of the neck to the pit of the stomach. *Hiccough* has been treated effectually, it is said, in the same way.

5. *Indolent Swellings.*

Various tumefactions, hypertrophic, rheumatic, and scrofulous, the result of simple chronic inflammation, or left behind after sprains or other injuries, have from time to time been treated by electricity in its different forms, and with more or less success.* The remedy probably operates as a simple excitant, hastening suppuration when the tendency is to that result, promoting the absorption of exuded fibrin and other secretions or depositions, and stimulating the disintegrating process, so as to favour resolution. Dr. Remak, of Berlin, states that he has found the constant current, produced by the arrangements of Daniell, Grove, and Bunsen, to have a powerful effect in resolving inflammatory tumours, by dilating the blood-vessels and promoting absorption. (*Med. Times and Gaz.,* May, 1858, p. 479.) It is highly probable that cases of palsy, dependent on chronic inflammatory thickening of the spinal membranes or ligaments, or similar thickening from exudation in the theca of nervous adelphia, who, after a careful investigation, reported in favour of the efficiency of the process employed. This consisted simply in passing the current from a magneto-galvanic machine through the tooth at the moment of extraction. A conductor from one pole was placed in the hand of the patient, and a wire from the other was attached to the forceps, by the contact of which with the tooth the circuit was completed. In numerous instances, the operation, according to the statement of the patients, was without pain; and the electric current, if care was taken to avoid the soft parts, occasioned little or no inconvenience. It was supposed that the nerve of the tooth, becoming benumbed by the electric influence, was rendered insusceptible to painful impression. The statements on the subject were received with incredulity by many scientific men, who did not think it possible that so powerful and speedy a benumbing effect should be produced by any amount of electric influence insufficient to occasion suffering to the patient; and many experiments afterwards made either proved less successful or failed entirely. The fact seems to be that, under the influence of a new sensation, and of new and strange manipulations, the attention of the patient was excited, and the cerebral centres so occupied as, in many instances, to be for the moment partially at least insensible to impressions usually productive of pain; on the same principle, probably, as that which operates when the pain of a violently aching tooth ceases entirely upon a mere visit to the dentist. It is certainly not impossible to produce a local benumbing effect by electric influence; but to do so the impression must be very powerful; so much so as to overwhelm nervous function by excess of excitement, and beyond anything that it would be prudent to employ for the mere purpose of saving pain in the extraction of a tooth.

---

* *Serous effusions* may be removed in the same way by the promotion of absorption; and cases of *hydrocele* have been treated effectually by both galvanization and faradisation, after failure with iodine injections and the seton. The method of proceeding is to introduce two acupuncture needles into the fluid, one at one end of the sac, the other at the other, and then connecting these with the poles of the induction machine or galvanic battery. A mild current should be used at first, to be gradually increased until the patient complains. The operation should continue for about twenty minutes. Sometimes the swelling disappears within twenty-four hours; sometimes three or four operations are necessary. (Althaus, *Med. T. and Gaz.,* Sept. 1862, p. 271.)—*Note to the third edition.*

CLASS I.

ARTERIAL STIMULANTS.

These are diffusible stimulants operating especially on the circulatory function, with little comparative influence on the nervous system. They have sometimes been called *Incitants* or *Simple Stimulants;* but it has seemed to me that the name here given best expresses their peculiar character. Of course, they in some degree affect the nervous system; for one great general function can scarcely be considerably excited without more or less involving the others; but their primary and prominent action is upon the heart and arteries.

The obvious effects produced by the arterial stimulants, as a class, are a sensation of warmth or heat in the stomach, increased frequency and force of pulse, and augmented temperature of the surface. They, in general, also act as powerful irritants to the skin when directly applied to it, and indeed to any sensitive part with which they may come into contact. Each one, however, has characteristic properties, distinct from that of simple diffusible stimulation.

They may be employed in all cases calling for stimulation, when the action of the heart is depressed, and are frequently thus used both externally and internally. They are specially applicable, and preferably to the other classes of diffusible stimulants, in those cases, enumerated in the general observations made upon diffusible stimulation, in which reaction must follow the state of prostration. In the *collapse attendant upon severe injuries,* and that *which occurs at the commencement of febrile diseases,* they are peculiarly indicated; because they have no special influence on the brain, and are not likely, therefore, as alcohol and some other cerebral stimulants, to affect that organ injuriously, when reaction takes place.

They are, in general, contraindicated by gastric inflammation, because brought into immediate contact with the inflamed part, and acting upon it with their whole stimulant power.

A great number of medicinal substances have the property of stimulating the circulation. Not to mention the nervous and cerebral stimulants, which, in accordance with their very definition, have this power, and, in some instances, in a very high degree, there are many others distributed among the various classes. But all of these have other properties which serve to place them elsewhere, and for which they are chiefly employed as medicines; and, though their action upon the heart and arteries may sometimes be incidentally useful, they are seldom or never employed with an exclusive view to this effect. The *aromatics* approach nearest in their properties to this class; but they are much more powerful as local than as general stimulants; and their application, as internal remedies, is almost restricted to affections of the alimentary canal. Mustard, copaiba, guaiac, mezereon, cantharides, savine, and many others, more or less excite the circulation; but each one of them belongs to some other class, as the emetics, diuretics, diaphoretics, emmenagogues, or alteratives; and they are almost never given as arterial stimulants simply.

The medicines strictly belonging to this class are very few, and might, perhaps, be still further limited; for carbonate of ammonia, which I attach to it, has, in addition to its influence over the heart and arteries, an action upon the nervous system, which would almost entitle it to a place among the nervous stimulants.

I. CAYENNE PEPPER.

CAPSICUM. *U. S., Br.*

Syn. *Red Pepper.*

Origin. Cayenne pepper is the fruit of *Capsicum annuum*, an annual plant from one to three feet high, inhabiting intertropical America, and supposed by some to be a native of the East Indies. It is cultivated in most civilized countries, and abundantly in the United States. Other species contribute to the Cayenne pepper of commerce. The fruit as grown in Cayenne, in South America, from which the medicine derived its common name, is said to be the product of *Capsicum frutescens*, and perhaps also of *C. baccatum*. Much of the powdered Cayenne pepper used in this country is brought from the W. Indies. Under the name of *Liberia pepper*, considerable quantities of a small fruit, about an inch in length, are imported from the coast of Africa. It is probably identical with that known in England as *Guinea pepper*, which Dr. Pereira ascertained to be the product of C. frutescens.

Properties. This fruit is a light shining berry, of various size and shape, and usually of a red or orange-red colour. The variety most employed in medicine is of a conical form, about as long as the finger, rounded at the base, and somewhat curved towards the smaller end. When cut open, it is seen to have two or three cells, containing flat whitish seeds, and a very loose medulla. When dried, it shrinks, becomes wrinkled, and assumes a darker colour.

As employed in medicine, capsicum is in the form of a powder, which is bright-red when fresh, but gradually fades, and in time loses almost all its colour. That imported is usually lighter coloured than our own, being brownish-yellow rather than red. It has a slight, peculiar, somewhat aromatic odour, and a bitterish, extremely pungent, burning, almost fiery taste, remaining long upon the tongue. It imparts its virtues to water, but more freely and largely to alcohol.

Active Principle. The virtues of capsicum probably reside in a peculiar resinoid matter, and, in a less degree, in a volatile principle on which its odour depends, but which does not appear to have been yet isolated. The *capsicin* of Braconnot contains the active matter of the fruit, but has been ascertained by Prof. Procter to be complex. The crystals, in which, as stated in the preceding edition of this work, the active principle was supposed to have been obtained, have proved, on further examination, to have been a salt of lead, from the acetate of that metal used in the process. From the most recent experiments it would appear that the activity of capsicum resides in a peculiar oleaginous liquid substance, which, however, is itself complex, consisting probably, of a bland fixed oil, and an acrid resinoid principle, which has not yet been procured in a pure state. For this principle when obtained uncombined, the name of capsicin should be reserved.*

Effects on the System. Cayenne pepper produces a sensation of heat in the stomach, diffuses a general glow over the system, and somewhat excites the pulse. In ordinary doses, it has no observable effect whatever on the brain, or general nervous system. Locally it is powerfully stimulating, more so proportionably than in its operation upon the circulation, and in this respect approaches the aromatics. On the skin it acts as a rubefacient. When taken into the stomach in excessive doses, it is capable of producing gastro-intestinal inflammation, with violent burning pain, vomiting, and purging; and is said to have caused vertigo and a sort of intoxication, but on insufficient authority. Any cerebral symptoms it produces are probably secondary and sympathetic. Used too largely and too long as a condiment, it may give rise to chronic irritation or secondary debility of stomach, and, by an over-stimulation of the blood-making functions, may favour the development of gout.

Therapeutic Application. The medicine may be used for the general purposes of the arterial stimulants, though less excitant to the circulation than others of the class. It has been employed as a safe stimulant in the cold stage of pernicious fever, and occasionally, as an adjuvant to other stimulants, in low typhoid fevers, when the stomach has been torpid, and the patient troubled with flatulence. In the low and malignant forms of scarlet fever, it has been much and advantageously employed; and it may be considered as among the best stimulants in that affection.

---

* See U. S. Dispensatory (12th ed., p. 208); and a paper by Mr. David Preston, in the *American Journal of Pharmacy* (May, 1865, p. 161).

I have myself given it frequently, and been satisfied of its beneficial effects. It is used both internally, and as a gargle. In the latter mode of application, I know nothing better adapted to that condition of the fauces, in which the mucous membrane has assumed a dark-red colour, and has begun to slough, or appears to be on the point of doing so. But it has also seemed to me useful in almost all varieties of the sore-throat of scarlatina, in which, so far from irritating, it often soothes; at least patients have frequently assured me that, though it burned their mouth in its passage, it had quite a contrary effect upon the fauces, which it greatly relieved.

In the early stage of scarlet fever, there is sometimes great backwardness in the appearance of the eruption. A few purplish points may serve to indicate the nature of the case, and the vain struggle of the system to throw out the irritation upon the surface. Along with this condition there may be coma, or a disposition to it, with an appearance of general prostration. In such cases, Cayenne pepper may be freely used, both internally, in connection with other stimulants, and outwardly as a rubefacient.

It has been used, as a pervading stimulant of the capillaries, in old cases of palsy; and has been highly recommended in uterine hemorrhage, in doses of from five to ten grains, repeated every ten minutes until the hemorrhage ceases. (Brock, *Assoc. Med. Journ.*, June, 1854, p. 582.)

In the *Dublin Medical Press*, Dr. Lyons recommends capsicum very highly in the early or forming stage of delirium tremens, stating that a single dose of twenty grains will usually cut short the disease; though, in persons of extremely intemperate habits, it may be necessary to repeat the dose three or four times. (*Med. Record*, Aug. 1, 1866, p. 260.)

As a local stimulant, it has been much employed in atonic states of the stomach, usually in connection with other medicines, to the action of which it is supposed to render that organ more sensible. The same influence is also extended to the bowels. It has been thought to be specially useful, in this way, in drunkards, whose stomachs have lost their excitability under the influence of strong drink. It has been given, with this object, along with sulphate of quinia in intermittents, with the simple bitters in dyspepsia, and with the cathartics in flatulence and constipation. It has also been specially recommended in the dyspepsia of gouty persons, and in convalescence from delirium tremens. Taken in the dose of a teaspoonful, at the very commencement of sea-sickness, it is said sometimes to set aside that affection. Much efficiency has also been recently claimed for it in hemorrhoidal tumours, given to an amount of from ten grains to two scruples in the course of the day. (*Ann. de Thêrap.*, 1858, p. 90.)

Topically, it is occasionally employed as a gargle at the commencement of ordinary angina, as a direct application in relaxation and elongation of the uvula, and externally as an active rubefacient.

Administration. The dose of the powder is from five to ten grains, to be repeated, in acute cases, every hour or two, in chronic cases, three or four times a day. The powder may also be used locally as a cataplasm, or as an application to the fauces. In young children, who cannot gargle, I have found much advantage, when the use of capsicum in this way was indicated, as in the gangrenous condition of the fauces in scarlet fever or malignant sore-throat, from mixing the powder with water into a sort of semifluid paste, and diffusing this over the fauces, several times a day, by means of a camel's-hair brush, or some similar implement. Should the child swallow a portion, it will be all the better. In the same way, it may be applied to the elongated uvula.

The medicine is sometimes used also in the form of *infusion* (INFUSUM CAPSICI, *U. S.*), which is made in the proportion of two drachms to eight fluidounces of boiling water, and given in the dose of half a fluidounce. In the same form, it may be employed as a gargle; but, for ordinary cases of sore-throat, it should be diluted with from four to eight parts of water.

The formula for the infusion of Dr. Stephens, which has been much used in scarlet fever, both internally and as a gargle, directs that two tablespoonfuls of the powder, and a tablespoonful of common salt, should be macerated for an hour in a pint of liquid consisting of equal parts of boiling-hot water and vinegar. This is to be strained, and given in the dose of a tablespoonful every half hour.

The officinal *Tincture* (TINCTURA CAPSICI, *U. S.*) may be used internally in the dose of one or two fluidrachms; as a gargle, mixed with water or rose-water in the proportion of half a fluidounce to eight fluidounces; and externally, hot and undiluted, as a rubefacient. It may also be applied of full strength, by means of a camel's-hair pencil, to the relaxed uvula.

II. OIL OF TURPENTINE.

OLEUM TEREBINTHINÆ. *U. S.*, *Br.*

Origin. As used in this country, oil of turpentine is obtained exclusively from our common or white turpentine, by distillation.

Properties. It is a limpid, colourless liquid, of a strong, peculiar odour, and a warm, pungent, bitterish, and very characteristic taste. This odour and taste have been assumed as a standard of comparison; and, when similar properties are observed in other bodies, they are said to be terebinthinate. The oil is lighter than water, volatilizable, highly inflammable, very slightly soluble in water, scarcely soluble, when quite pure, in cold officinal alcohol, and readily dissolved by ether. On exposure to the air, it absorbs oxygen, and becomes yellowish and thicker, in consequence of the formation of resinous matter, which is held in solution in the oil. In time, it is in this way rendered very impure. But, as the resin formed is readily soluble in alcohol, the oil may be purified by agitation with that fluid, which dissolves the impurity, and leaves the oil fit for use. When quite pure, it is composed of hydrogen and carbon exclusively; but, as found in the shops, it almost always contains oxygen absorbed from the air.

Effects on the System. The first effect of oil of turpentine, when given to a healthy person in moderate doses, is usually a feeling of warmth in the stomach, which is followed by a glow over the system, and, after a short time, by increased frequency of the pulse. There is also generally an increased secretion of urine, which has a violet odour; and, after the oil has been taken for some time, a terebinthinate smell is perceptible in the breath, and the exhalations from the skin. The oil is said, moreover, to be diaphoretic. This effect I have not noticed as a common event; though, in certain conditions of low fever in which it is given, I have often observed a soft and natural state of the skin following a dry and hot condition; but this change I have ascribed rather to the effect of the medicine in relieving the disease, and removing a source of irritation to the surface, than to its direct action on the perspiratory function. The kidneys and urinary passages are the parts in which the operation of the oil, after entering the circulation, is most obvious. Though, as stated above, the urinary secretion is usually increased under the stimulation of the medicine, yet, after some days, irritation is often produced, amounting even to strangury, and attended occasionally with bloody urine; and the secretion is now diminished, instead of being augmented. With these phenomena, there is an entire absence of any evidence of special action on the brain or nervous system generally.

From larger quantities, if within the limits of two fluidrachms, no other observable effects ordinarily result than perhaps some increase of the phenomena mentioned, and a disposition to disturb the bowels, which is sometimes also evinced even by the common medicinal doses.

If the quantity be increased beyond half a fluidounce, up to one, two, or three fluidounces, a greater degree of general excitement is produced, in which the brain now participates; feelings of fulness of the head, and slight vertigo, being experienced, and sometimes, it is said, drowsiness, or a confusion of mind bordering upon intoxication. A condition resembling trance is said to have been experienced in one instance. In the doses mentioned, the oil not unfrequently occasions nausea, and sometimes vomiting; and in a short time, usually within an hour or two, purges actively; after which the cerebral symptoms subside. These symptoms may possibly be the result of a sympathetic impression upon the brain, extended from the irritated stomach, as might be inferred from their quick occurrence, and their rapid disappearance upon the discharge of the oil by the bowels. Another evidence, to the same effect, is that large doses of the oil are less apt to produce irritation of the urinary passages than the smaller doses frequently repeated; showing that an equal amount of absorption has not taken place. The severer head symptoms are most apt to occur when the medicine does not, as sometimes happens, operate on the bowels. In this case, too, the exhalations from the skin and lungs are highly terebinthinate, and the urine has the violet odour strongly.

Like most other stimulants, the oil sometimes appears to act as an emmenagogue.

It can scarcely be considered poisonous; as not less than four fluidounces are asserted to have been taken without serious consequences. On the lower animals, however, it would seem to act deleteriously; for two drachms, given to a dog, are said to have proved fatal in three minutes, with symptoms of tetanus, and great prostration. (Pereira, *Mat. Mat.*, 3d ed., p. 1193.) A case, moreover, has been recently recorded, in which death was supposed to have been occasioned in a woman by six fluidounces of the oil; but the circumstances of the case are so obscure, as to leave the real cause of the fatal result uncertain. (See *Am. Journ. of Med. Sci.*, N. S., xxxvi. 562.) As to the alleged poisonous effects resembling those of lead, said to have been produced by exposure to the exhalations from a newly-painted room (*Gaz. Méd. de Paris*, 1855, No. 52), and which were ascribed to the oil of turpentine used in the paint, there cannot be the least doubt that they were really owing to the lead which must have risen with the vapours; for long exposure to the pure vapours of the oil, which is not uncommon in this country, never occasions such effects; while, as before stated in this work, it is well known that painters who use this oil in mixing their paints are peculiarly liable to lead-poison.

The oil is undoubtedly absorbed. Tiedemann and Gmelin detected it in the chyle of animals to whom it had been given. The odour of the urine, and that exhaled from the lungs and skin, are of themselves sufficient proof. It may be absorbed into the system when inhaled in the form of vapour. I have had under my care a young man, attacked with strangury and bloody urine, from being confined on board of a vessel loaded with turpentine, during a voyage from North Carolina to New York; and he informed me that another of the crew was affected in the same manner.

When applied to the skin, the oil acts usually as a powerful rubefacient.

THERAPEUTIC APPLICATION. From the variety and importance of its therapeutic effects, oil of turpentine deserves to rank among the most valuable medicines. In regard to some of these effects, the anthelmintic, namely, the rubefacient, and those exerted on the urinary organs, it will be considered elsewhere. In this place, it is to be treated of mainly as a stimulant, either generally to the system, or locally to the alimentary mucous membrane.

Cold Stage of Fevers. In consequence of the absence of any direct effect on the brain, at least in ordinary stimulant doses, the oil may be given in all instances of depression or collapse, occurring in the cold stage of febrile diseases, when internal stimulation is required. In some cases of this kind, I have known it to be very useful; and it may be given with great freedom.

Low Fevers generally. It has also been considerably used as a stimulant in low states of fever, especially when the existence of disorder of the brain may be supposed to contraindicate the alcoholic liquors, and other cerebral stimulants. In typhus and typhoid fevers it has long been employed with this view; and I found it in use upon entering into the practice of medicine, nearly fifty years ago. But it was given only as a stimulant, and, though successful in some instances, appeared in others to display little remedial power. I claim to have discovered the principle upon which its special success in these cases depended, or at least the precise circumstances under which it proved successful; so that its employment may now be regulated with considerable confidence of gaining the results aimed at. As a mere stimulant, it may be employed in most instances of low fever, but must take rank with others of the class, and indeed below several of them. In regard to the special object which I now have in view, it can be replaced, so far as I know, with equal benefit, by no other medicine.

The *advanced stage of the fever named specifically typhoid fever*, but for which I have ventured to propose the name of *enteric fever*, affords the condition here referred to. I may, perhaps, be excused if I relate the circumstances which led me to this discovery; as I shall thus be able to produce a stronger impression on the reader than by a mere abstract statement of results. In the year 1823, I had under my care a case of fever of the kind then known as nervous fever, or slow remittent, or typhus mitior, by which titles it was variably and somewhat indefinitely called, in the advanced stage of which, violent peritoneal inflammation came on, ending speedily in death. On examination, I found a number of ulcerated surfaces in the mucous membrane of the ileum, in one of which, near the cæcum, a large perforation existed, through which a portion of the contents of the bowels had passed into the peritoneal cavity. In this case there had been tympanitic abdomen, and the tongue, after having parted with a portion of the fur in the *centre*, leaving a *smooth moist red surface*, had suddenly ceased to advance in the cleaning process, and become *quite dry* before the occurrence of the perforation. Not long previously to this, I had witnessed a fatal case in the practice of a friend, which, after an abortive attempt to clear the tongue in a similar manner, with a similar dryness afterwards, had become aggravated, and ended fatally. Comparing these cases, I was induced to think that the peculiar condition of the tongue referred to, with the tympanitic abdomen, might be the result of the ulceration of the ileum, and that, if I could find a medicine which would correct this ulcerative condition, I might possibly in future save my patients under similar circumstances. Not long afterwards another case presented itself, having the same distinctive characters. Terebinthinate remedies having been found useful in ulcerative affections of the bowels, it occurred to me that the oil of turpentine might possibly answer my purpose in this instance I gave it accordingly. In twenty-four hours, the tongue showed a disposition again to become moist, a little white fur began to appear on the part before denuded, there was an amelioration of the other symptoms, and from that time the march towards health was uninterrupted under the continued use of the remedy, though I had in the beginning almost despaired of my patient. Other cases occurred afterwards, of the same character, and with the same results; and from that time to the present, though I have seen great numbers in my private practice, in consultation, and in the Pennsylvania Hospital, I have lost only two, presenting the phenomena mentioned. Of these two, one exhibited, on examination after death, such an amount of disease in the ileum as to have rendered a fatal issue unavoidable; and in the other, a small ulcerated opening was found at the bottom of an offset of the bowel, or cul-de-sac, about an inch and a half in depth, into which, as it was filled with mucus, the oil had been unable to penetrate, so as to come into contact with the surface of the ulcer; while several large ulcerated patches in the ileum were rapidly cicatrizing, showing the probably beneficial influence of the remedy on them. A brief account of the use of the oil in this condition of febrile disease, and of the circumstances which led to it, was published in the *North American Medical and Surgical Journal* for April, 1826 (*page* 272). When the admirable work of Louis on typhoid fever appeared, I at once recognized, in his description, the disease which had exhibited the phenomena above mentioned. The ulcerative condition referred to, I had previously considered as liable to occur in any protracted fever. I now learned that it was the characteristic lesion of a special disease. My therapeutic views, therefore, were immediately transferred to the typhoid fever, which Louis had enabled us accurately to diagnosticate, and, having tried the remedy in this affection, I found my best hopes fulfilled. Ever since that time, I have been in the habit, in my lectures in the University of Pennsylvania, of strenuously recommending the oil of turpentine in the treatment of enteric or typhoid fever, and have done the same in my work on the Practice of Medicine, always restricting its use to the period of probable softening and ulceration in the diseased glandular patches, and expressing my belief that it was no specific in that disease, but might be confidently relied on as having a favourable influence over this peculiar morbid affection of the bowel, and vastly diminishing the danger from that source. Abundant testimony has been given to me, by practitioners from various parts of the Union, of very favourable changes having taken place in the mortality of the disease, after they had adopted the practice here recommended. It will be best, probably, after this brief history, that I should state distinctly, the condition under which, in enteric fever, the oil may be beneficially employed, and the principles upon which I believe it to act.

Enteric or Typhoid Fever. Though the oil may be of some use as a mere stimulant in this disease, it is, in that respect, of but comparatively little value, and cannot be depended on to the exclusion of wine-whey, carbonate of ammonia, and nutritious aliment, in low conditions of the fever. But the oil will accomplish what these cannot. It acts most happily in stimulating the diseased patches of Peyer's glands, and the isolated glands of the same kind, whereby the softened and disorganized matter is more readily thrown off, and the ulcerated surfaces disposed to heal, when they might otherwise be unable to do so. The remedy, therefore, is to be given at the period during which the discharge of the softened matter is going on, and ulcers are forming, or in existence. This is usually, I believe, about the middle, or towards the close of the second week. Before this time I count upon no material service from the oil. It is now that the tongue becomes *dry;* and the occurrence of this *dry state of the tongue*, in a decided degree, is the signal for commencing with the use of the remedy. I give it usually in doses of ten drops every two hours, but sometimes increase to fifteen or twenty drops. At the end of twenty-four, or at the furthest of forty-eight hours, there may very generally be seen a *return of moisture with a white fur* on the surface of the tongue at the sides, for its whole length, leaving the surface in the middle still dry and often cracked. With this amendment, there is often also a diminution of the tympanites, a cooler and moister skin, and a less frequent pulse. The same change goes on till the whole tongue becomes moist, and covered usually with a whitish fur, which then gradually disappears, commencing from the tip and edges. Sometimes, even when there has been no dryness of the tongue in the case, I have found the oil to act favourably in ameliorating the symptoms; and frequently, when the disease has appeared to linger in its advanced stages, and, though not severe, to show a perverse disposition to hang on to the patient, I have seen it almost immediately enter into convalescence under the use of the remedy. Again, when the case is marked in its progress by the cleaning of the tongue by flakes or in patches, leaving a red and smooth surface, as if deprived of the outer layer of the epithelium and papillæ, and when the surface of the tongue, whether completely or only partially cleared, instead of remaining moist, as it does in favourable cases, becomes very dry, with an aggravation of the general symptoms, I take it for granted that there has been a corresponding unfavourable change in the intestinal ulceration, indicating the use of the oil. It is precisely under these circumstances that, previously to my original use of the oil, I had seen a majority of the cases that came under my notice prove fatal; and, since the use of it, only two. I do not claim for the oil any specific power over typhoid fever. It will not prevent death from intercurrent pneumonia, or meningitis, or various other sources of mischief; but I do think, as the result, too, of great experience in the disease, that so far as the mere affection of the intestinal glands and its direct consequences are concerned, it will vastly diminish the chances of a fatal issue. The reason why, in the special condition of the tongue last described, the favourable effects of the remedy may be almost certainly calculated on, is that, at the commencement of the cleaning process, the proper idiopathic disease has about run its course, and would almost certainly end well, but for an unfavourable change in the condition of the ulcerated surfaces; and whatever, therefore, will favour the healing of these, will in all probability secure a favourable termination. I have been more particular in this account of the use of oil of turpentine in enteric fever, because I have great confidence in the efficiency of the remedy myself, and wish to prevail on others to use it by showing the grounds of this confidence, and pointing out the precise circumstances under which, according to my experience, it should be employed.

Scarlet Fever. In the advanced stage of this complaint, a troublesome diarrhœa not unfrequently supervenes, which is sometimes, I believe, sustained by ulcers in the small intestines. It is not uncommon for this condition to be attended by a dry tongue, as in enteric or typhoid fever. Under these circumstances, I have prescribed the oil of turpentine with apparent benefit.

Dysentery and Diarrhœa. Whenever, in the course of these complaints, whether acute or chronic, the tongue exhibits a smooth surface, as if deprived of its papillary structure, and at the same time becomes perfectly dry, I always unhesitatingly employ the oil of turpentine, believing that this aridity indicates a deficiency of the vital forces, which calls for the stimulating property of the oil, while the probable existence of ulcers in the bowels requires its alterative action. In chronic dysentery, particularly, I have repeatedly seen the happiest changes effected by the remedy, under the precise circumstances mentioned, and would strongly urge upon the reader a trial of it. One instance occurs to me, in which the patient had been very long ill, and was reduced to the lowest condition compatible with life. No one who saw the case had any hope of a cure. But the same favourable change took place, under the use of the oil, as in the analogous condition in enteric fever, and the patient recovered. I seldom fail, in such cases, in restoring moisture, and an otherwise favourable condition to the tongue, even though the disease may prove ultimately fatal. The oil should be combined with a little laudanum in these cases.

Gastritis and Yellow Fever. In the last stage of inflammation of the gastric mucous membrane, when the skin has become damp with cool sweats, hiccough has set in, and the patient vomits dark matter; in short, when symptoms of threatened gangrene appear, the oil of turpentine with laudanum sometimes offers a last chance for safety. It acts as a stimulant and alterative to the diseased surface, while it somewhat stimulates the system. I have seen at least one apparently desperate case recover from such a condition under the use of it. Now this condition is very frequently presented in the second stage of yellow fever, anticipatory or attendant on black vomit. The oil has been highly recommended under these circumstances, being commenced with after the subsidence of the primary fever. Some have even employed it throughout the disease; but in the early stage, when the gastritis is yet active, the use of a powerful local stimulant like this would not correspond with my views of sound therapeutics.

Puerperal Fever. Dr. Brenan, of Dublin, has spoken in the strongest terms of the usefulness of this remedy in puerperal fever. He gave it in doses of one or two tablespoonfuls every three or four hours, and at the same time covered the abdomen with flannels saturated with the oil. There is no doubt that benefit may accrue from the external use of the remedy in the way mentioned; and, in the malignant forms of the disease, when the blood is impaired, and the inflammation partakes of the same depraved character, it is not impossible that the powerful revulsion towards the inner from the outer surface of the bowels may have proved useful. The recommendation of Dr. Brenan has not been without the support of other highly respectable practitioners; but the remedy has not been adopted by the profession generally; and it certainly appears to be contraindicated in all cases of genuine vigorous inflammation, in which it might be proper to employ the lancet. I cannot, however, speak of it from experience.

Chronic Rheumatism and Gout. Oil of turpentine has considerable reputation in these affections, more especially the former, in which it is said to have sometimes proved very efficacious. It has been more particularly recommended in this disease, in the forms of lumbago and sciatica. The oil is undoubtedly a penetrating remedy, reaching the minutest capillaries, and apparently acting on them with considerable energy. It may thus prove alterative in some of those obstinate rheumatic cases, which have taken so deep a hold of the tissues, as to be incapable of being unseated by anything which cannot be brought to bear with considerable force immediately upon the molecules of the tissue affected. I have no faith whatever in the diaphoretic action of the oil, to which some have been disposed to ascribe, in part at least, its efficiency in rheumatism. The medicine has not only been used internally, but has also been applied in the form of a bath of the vapour at a temperature of from 140° Fahr. to 180°, which is said to be well borne. In this case it is probable that the diaphoretic effect of the heat may add to the efficiency of the oil. (Bull. Gén. de Thér., xxvii. 86.)*

Nervous Diseases. Cures are stated to have been effected by the oil of turpentine in neuralgia, chorea, epilepsy, and hysteria; and it is probable that, largely employed, it may sometimes cure these affections when purely functional, by its strong influence upon the [illegible] movements of the tissues through the capillaries, and its revulsive action towards the alimentary canal; but I cannot recommend it on the ground of my own experience. A case of recovery from tetanus, [illegible] under its use, is reported by Prof. H. L. Byrd, of the Oglethorpe Medical College in Georgia. (Charleston Med. Journ. and Rev., x. 474.)

Hemorrhages. Oil of turpentine is among our best hemostatics. Some have supposed that it operates in the hemorrhages by an astringent property. But I have not been able to discover that it has this property in the slightest degree. On the contrary, its tendency is to expand the capillaries of the part with which it is brought into contact.

---

* For a particular account of the origin, construction, application, and uses of these terebinthinate vapour baths, the reader is referred to an article by Dr. M. Macario, in the numbers of the *Archives Générales* for April and May, 1859, pages 385 and 523. By this writer it is stated that cures are sometimes obtained in chronic gouty, rheumatic, neuralgic, and catarrhal affections, which have resisted all other remedies. He does not think the temperature should be higher than between 110° and 140° Fahr., which is sufficient for all the objects aimed at. The patient is placed wholly within the bath, the vapours of which, therefore, act as well through the respiratory organs as upon the surface of the body. When there is no great occasion for haste, it is sufficient to administer the bath every other day. Under the influence of the bath, the pulse generally becomes more frequent, sometimes beating 130 in the minute, while the respiration remains normal; the whole surface is reddened; and a profuse perspiration breaks forth, which, however, does not have the effect of weakening the patient. Very seldom is headache or other evidence of congestion of the brain experienced. As effects of the bathing, moreover, the appetite and thirst are increased, and digestion accelerated; the urine, though remaining about normal in quantity, acquires a strong violet odour; and occasionally, especially in nervous subjects, the nervous system is considerably disturbed, as shown by restlessness, irritability, and want of sleep. The skin is sometimes covered with a miliary eruption, and sometimes affected with furuncles in variable numbers and size. M. Macario considers the baths applicable not only to the affections mentioned, but also to chronic affections of debility, as *scrofula*, *stiffness and contraction of the limbs*, and *palsies of a rheumatic character*. They are contraindicated in acute diseases generally, attended with phenomena of excitation. (*Note to the second edition.*)

But we do not know the precise condition of the minute vessels in hemorrhage; and it may well be, that the stimulant and alterative influence of the oil upon them may check the hemorrhagic tendency without diminishing their volume. The conditions which I have considered as prerequisite to the use of the oil, are the absence of general febrile excitement, and of active congestion in the part affected. Under these circumstances, it may be tried in any of the hemorrhages; but that in which, according to my own observation, it has proved most efficient, is the hæmoptysis of consumptive patients, or of persons supposed to be consumptively inclined. In this affection, it has proved in my hands more effectual than any other remedy, or combination of remedies. I was first induced to employ it, from having noticed its great efficiency in a medical student more than thirty years ago, who had employed it in his own case, in a very severe attack. This student is now Dr. James L. Pierce, of Philadelphia. Since that time, I have used it very successfully, and sometimes when all other remedies had been without effect. Should evidences of active congestion be present, they should be removed by cups or leeches before the use of the oil; at least this is the method which I have generally followed.

Chronic Bronchitis. This affection, when attended with copious expectoration, is said to have been advantageously treated with the oil; as have other excessive mucous discharges.

Dr. D. S. Brandon, of Georgia, speaks favourably of its use in *stomatitis materna*, having found it very efficient in the dose of twelve drops three or four times a day. (*Am. J. of Med. Sci.*, April, 1860, p. 576.)

Affections of the Stomach and Bowels. In gouty *spasm of the stomach*, *flatulent colic*, *excessive flatulence without spasm*, and a *tympanitic state* of the abdomen, the oil is often beneficial through its direct stimulant influence. In tympanites, given both by the mouth, and in the form of enema, it is one of the most effectual remedies. It may be employed also in *hiccough*, and has been recommended, in combination with ether, as one of the best remedies in *biliary calculi*. But experience has not proved its efficiency in the latter affection; and it is difficult to imagine in what way it could prove serviceable, unless possibly sometimes by relaxing the spasm attending the passage of these calculi through the ducts.

The external use of the oil will be treated of under the rubefacients; its employment in affections of the urinary passages, under that of diuretics; and its application as a vermifuge, under the anthelmintics.

Administration. The dose of the oil for the purpose of a general stimulant is five to twenty drops, repeated every half hour, hour, or two hours, in acute cases, and three or four times a day in chronic. But the dose may be much increased if thought advisable. Should it occasion strangury or bloody urine, it should be suspended. It may be administered dropped on sugar, or in the form of emulsion, made by suspending it in water by means of gum arabic and loaf sugar; each tablespoonful of the emulsion containing a dose of the oil. Laudanum may often be usefully added, either when the oil is disposed to purge, or when there is an indication for the checking of diarrhœa at the time of its administration.

Its use in the form of enema will be treated of under the head of the cathartics.

It has been recommended in the form of bath, for its constitutional impression, by Dr. T. Smith of Cheltenham, England, who employs in each bath from five to ten fluidounces of the oil, a fluidounce of the oil of rosemary, and two pounds of carbonate of soda.

Its external use in the form of a vapour-bath in chronic rheumatism has already been noticed. In scabies it is said to effect an immediate cure, if the patient sprinkle about a fluidounce of it, before going to bed, upon the sheets and the clothing in which he is to sleep. (*Am. Journ. of Med Sci.*, N. S., xxxiv. 232.)

Skoda recommends the inhalation of its vapour in gangrene of the lungs.

III. CARBONATE OF AMMONIA.

AMMONIÆ CARBONAS. *U. S.*, *Br.*

Preparation. Carbonate of ammonia is prepared by subliming a mixture of carbonate of lime and muriate of ammonia. The muriatic acid and lime, reacting upon each other, produce chloride of calcium and water; and the water thus formed unites with the carbonic acid and ammonia to generate the compound under consideration, which rises in vapour, and is condensed in a proper recipient. During the process a portion of ammonia is liberated. The cake formed by the condensation of the vapour is broken into lumps, which should be kept in a well-stopped bottle.

Composition. This is not a neutral carbonate, as its officinal name implies, but either a sesquicarbonate, consisting of three equivalents of carbonic acid, two of ammonia, and two of water, or, as some chemists prefer to consider it, a compound of one equivalent of the proper carbonate of ammonia and one of the bicarbonate. When purified by a second sublimation, it is said to lose a portion of carbonic acid, and to become the 4–5 carbonate of ammonia, thus acquiring more stimulating properties.

Properties. The salt, as kept in the shops, is usually in whitish lumps, more or less rectangular, hard, fibrous, translucent, of a characteristic very pungent odour, and an acrid, alkaline, yet somewhat cooling taste, with a burning sensation in the throat, which renders it difficult of administration to persons of very sensitive fauces. It is very soluble in cold water, and freely dissolved by proof spirit; but is scarcely soluble in pure alcohol. By heat it is wholly volatilized. Exposed to the air, it gradually parts with the proper carbonate of ammonia, and is ultimately converted into the bicarbonate, becoming at the same time quite white, opaque, and disposed to crumble. I have noticed that, after long exposure, the resulting substance deliquesces, and ultimately assumes the liquid form.

The lumps should always be translucent when held up to the light; otherwise they have undergone more or less completely the change just referred to, which is a deterioration, as the bicarbonate is much less stimulating than the officinal salt. A loss of odour, and of the property of changing to brown the yellow colour of turmeric paper held over it, are also signs of deterioration.

Incompatibles. A solution of carbonate of ammonia is decomposed by most acids; by potassa, soda, and their carbonates; by lime-water and magnesia; alum and corrosive sublimate; by the soluble salts of lime, lead, zinc, and iron, excepting the tartrate of iron and potassa and the analogous ferruginous compounds; and by most salts with excess of acid, as the bitartrate and bisulphate of potassa.

Effects on the System. Carbonate of ammonia is irritant in its local action, and an energetic stimulant to the system. Taken internally, it occasions a sense of heat in the stomach, increases the frequency and force of the pulse, and produces a general glow through the system. Though sometimes causing a sensation of fulness in the head, it has no conspicuous influence over the special cerebral functions; and there are few substances so actively stimulant to the circulation, with so little obvious effect on the brain. It appears to excite more or less the general organic nervous system, and might even rank with the nervous stimulants; but its influence on the circulatory system is so much more decided, and its best therapeutic uses are so closely dependent on this action, that I have concluded to rank it in the present class, with this explanation as a caution to the learner. As a diffusible stimulant, it is remarkably characterized by the brevity of its action.

With its general stimulant influence on the circulation and organic nervous system, it has a tendency to increase the secretions. It often produces more or less diaphoresis, sometimes operates as a diuretic, and appears to act on the pulmonary organs, if not as an expectorant, certainly as a special stimulant of the respiratory function.

In over-doses it irritates the stomach, and, if not discharged by vomiting, which generally happens when it is given very largely, may produce dangerous inflammation of the mucous membrane, with severe burning pain. It is probably only in this way that it is capable of acting as an acute poison in the human subject; but Huxham relates a case in which its long-continued use was followed by a cachectic state of system and depraved state of the blood, as indicated by hemorrhage from the nose, gums, and intestines, pustular eruptions on the surface, dropping out of the teeth, and a general wasting of the body, with hectic symptoms. The patient ultimately died from the effects of the poison. These probably depended mainly upon a constantly sustained excess of alkalinity of the blood. Two drachms and a half given to a dog were found by Orfila to produce gastric inflammation with tetanic spasms. The obvious antidote, should an over-dose be taken, would be one of the mild vegetable acids, as the acetic in the form of vinegar, the citric in that of lemon or lime juice, or the tartaric.

Therapeutic Application. In an impure form this salt has long been used in medicine, under the names of *sal volatile, salt of hartshorn*, etc. It may often be very usefully employed. In consequence of the energy and, at the same time, brevity of its stimulant action, it is admirably adapted to all those cases of *sudden depression or collapse*, which, if the patient survive, must be followed by febrile reaction, if not acute inflammation. The want of any special influence on the brain adapts it peculiarly to those in which the reaction will be likely to be attended with inflammation or great vascular excitement of that organ. Instances of the kind are not unfrequently presented in the cold stage of febrile diseases, the collapse of concussion of the brain, and the prostration of any sudden shock. Under these circumstances, it is an admirable adjuvant of the hot bath.

In all *fevers, assuming in their progress a low form*, requiring stimulation, this is one of the first of the diffusible stimulants which may be had recourse to. In *typhus* and *enteric fevers*, in the various *exanthemata* assuming a typhoid condition, especially *scarlatina, smallpox*, and *malignant erysipelas*, and even in the *phlegmasiæ* when attended with the same state of system, it may often be used very advantageously, associated with other stimulants, especially with wine-whey, and the preparations of Peruvian bark. Its tendency to produce softness or moisture of the skin, adds to its usefulness; and sometimes, when the breath and exhalations from the patients have a sour smell, as they are apt to have in low fevers, its property of neutralizing acid, may be considered a peculiar recommendation.

In the *malignant pustule, carbuncle, glanders, metastatic abscess*, and *all cases of purulent infection of the blood*, and other affections of a similar kind, accompanied with a depressed condition of the system, it may be used, conjointly with other stimulants, with hope of benefit.

There are few conditions in which it acts more happily than in the *advanced stages of the different pectoral inflammations*, when the occurrence of suppuration with a tendency to prostration calls for the use of stimulants. I have frequently seen it of the greatest possible service in *pneumonia* under these circumstances, when the severe oppression of breathing, the cool skin, the feeble pulse, and the sweats at night, have indicated the probable approach if not occurrence of the third stage of the disease, and the absolute necessity of supporting treatment. I do not think it is going too far to say that I have repeatedly, in this condition, known it to be the main agent of safety to the patient. It probably operates, under such circumstances, not only by a general stimulation of the circulatory and nervous systems, but also by a special excitation of the ultimate tissue of the lungs, concerned in the respiratory function. In a somewhat less degree, it often proves serviceable in protracted *acute bronchitis*, with a suppurative condition of the mucous membrane. In *chronic bronchitis* also, and in *phthisis*, when the lungs are loaded with pus, and too feeble to discharge it effectually, the carbonate of ammonia yields much relief by stimulating the expulsive power.

It has been recommended both in *chronic and acute rheumatism*. There is a condition of the latter affection in which it may be very appropriately employed. This condition consists in an asthenic state of system, probably dependent on impoverished blood, in which, though there may be considerable inflammation, it is apt to be movable, changing its seat from place to place, and a good deal of nervous irritation mingles with it, along with a frequent but feeble pulse, a tendency to paleness, and, perhaps, coolness of the surface, and sweats during sleep. This is altogether different from the typhoid state of the system, with depraved blood, and yields more happily and speedily to a well-directed stimulation. Perhaps the use of the medicine may be ascribed in part to its alkalinity, which is indicated sometimes in these cases by an excess of acid in the system. In *chronic rheumatism* the medicine is usually given in connection with guaiacum, in the form of the ammoniated tincture of that resin; and probably acts by stimulating, in a manner similar to that of oil of turpentine, the ultimate structure of the inflamed tissue into a new action, which may supersede the old.

The medicine has been recommended in *scrofula;* but it exercises no special influence over the diathesis, and only proves beneficial sometimes in states of depression attendant on this disease, as in a similar state in any other.

As an antispasmodic in the *nervous affections* it has received high commendation. *Hysteria* and *epilepsy* are the particular complaints in which it has been most praised. In the former affection it will no doubt often prove beneficial, partly, in all probability, by a direct stimulation of the nervous centres, but much more, I believe, by obviating the flatulence, spasmodic pains, and other disordered sensations in the stomach and bowels which so often attend and aggravate the disorder. In *epi-*

lepsy, when entirely functional, it may sometimes prove beneficial. Dr. Pereira thought he had derived much advantage from it both in epilepsy and hysteria, given in doses of fifteen or twenty grains three times a day, and continued steadily for two or three weeks.

Dr. Barlow recommends carbonate of ammonia in *diabetes*, in conjunction with a diet of animal food and the cruciferæ, exercise, the warm bath, and opiates; but experience has not proved it to possess any special influence over that complaint. (*Brit. and For. Med. Rev.*, Oct. 1841.)

Cazenave has found it useful in *scaly affections* of the skin; but a much more effectual remedy, in these complaints, is arsenic in some one of its medicinal forms; and it is scarcely advisable to postpone the cure by using substitutes which exercise a comparatively feeble, and at best uncertain influence over the disease.

Carbonate of ammonia has been much commended for the possession of certain *antidotal virtues*. In the depressed state of system resulting from sedative poisons, such as *tobacco*, *digitalis*, and *hydrocyanic acid*, it is obviously indicated as a rapid and active stimulant; but, in regard to hydrocyanic acid, it has been supposed to have special powers as an antidote. Whether it can be of any service chemically by neutralizing the poison, is a matter of some doubt; but it should at least be employed as one of the most efficient agents, if not the most efficient, in counteracting its effects.

Either in this form, or that of solution or spirit of ammonia, the volatile alkali has obtained great credit, as an antidote to the *bites of poisonous animals*. Numerous cases are on record in which, applied locally and taken internally, it has been supposed to prevent the poisonous effects of the bites of serpents. But as these bites often produce no fatal effects if left alone, it is extremely difficult to decide upon the amount of credit which the supposed antidote may really merit. The reputation of the medicine was mainly based on the apparent success of the *eau de luce*, a liquid containing ammonia as its chief ingredient, which was given by Bernard de Jussieu to a servant bitten by a viper. But Fontana proved that the bite of the viper rarely causes death, and that its effects are in no degree diminished by the use of ammonia; and the same observation was extended to the bites of venomous insects. Trousseau and Pidoux state that they have never seen the external or internal use of ammonia modify, in the least degree, the symptoms of poisoning by the bites of venomous animals. (*Traité de Thérap.*, 4e ed., i. 336.) I have never had the opportunity of trying the remedy in any serious case of the kind.

Another antidotal application of ammonia has been to the relief of the *intoxicating effects of alcoholic drinks*. Over absolute drunkenness it has no control whatever; but, in slight disorder from this cause, either the carbonate of ammonia, or the alkali itself in aqueous or spirituous solution, occasionally gives relief.

The local effects of carbonate of ammonia on the stomach and bowels are often advantageous. In *excess of acid* with a *languid state of the stomach*, such as not unfrequently exists in *dyspepsia*, in *sick-headache* with the same complication, and in the spasmodic pain or other uneasiness of *flatulence* and *atonic gout*, it may be prescribed alone, or in connection with tonics and purgatives; but the aromatic spirit is usually preferred, under these circumstances, to the carbonate in its ordinary form.

The main contraindication to the use of carbonate of ammonia, in cases which may seem to call for it, is the existence of inflammation of the stomach.

Administration. The dose of the medicine is from two or three to twenty grains, repeated every half hour, hour, or two hours. From five to ten grains every hour or two is the ordinary dose in low fevers. Thirty grains or more will generally vomit. The medicine may be given in pill or solution; but the latter is the better form; because, should the pill come in contact with the mucous coat of the stomach, it would be more apt to excite irritation. But the acrimony of the salt should be covered by mixing it, in solution, with gum arabic and loaf sugar, and the taste corrected by using one of the aromatic waters as the vehicle.

Carbonate of ammonia, broken into minute fragments, and mingled with the volatile oil of bergamot, lavender, or other aromatic, is put into small bottles, and used as smelling salts. The ammoniacal odour, which is rendered agreeable by that of the volatile oils, is pungent and exciting; and the preparation is frequently used by delicate persons to obviate unpleasant *nervousness*, and to relieve *faintness*. Indeed, the application of ammoniacal vapour to the nostrils is one of the most efficient of the milder methods of preventing or remedying *syncope*. For this purpose, either the carbonate may be used, or one of the liquid preparations of ammonia to be mentioned directly. They are simply held to the nostrils, so that the patient, if still breathing, may inhale the vapour with the air; and even without inhalation, a portion of the vapour will enter the nostrils on the principle of the diffusion of gaseous bodies; but caution is necessary, especially when the patient is insensible, that the vapour should not be too concentrated, nor too copiously applied; as there is risk of producing severe inflammation of the nostrils, of the larynx, and even of the bronchial tubes, when it is carried into the lungs with the inhaled air.

The salt is sometimes used externally, mixed with olive oil, as a mild rubefacient liniment. A liniment was directed by the London College, though discarded in the British Pharmacopœia, made by mixing a fluidounce of a saturated solution of the salt with three fluidounces of olive oil. An imperfect soap was thus formed; but the union of the oil with the carbonate is less perfect than with the solution of ammonia, and the preparation is consequently less elegant than the officinal liniment of ammonia.

There are several other ammoniacal preparations which are more or less used internally for their stimulant effects.

1. WATER OF AMMONIA.—AQUA AMMONIÆ. *U. S.*—LIQUOR AMMONIÆ. *Br.*, *U. S.* 1850.—*Solution of Ammonia.*

This is water impregnated with gaseous ammonia. As it is much more used as an external irritant than as a stimulant internally, it will be more particularly treated of among the rubefacients. Its effects upon the system are essentially the same as those of the carbonate above described, and it may be used for the same purposes; but, as it would be more likely, if given in excess, to irritate or inflame the stomach, the salt is generally preferred. As a stimulant antacid, it is sometimes used in *heartburn*, and in *sick-headache* dependent on acidity of stomach; and it has had considerable reputation as an antidote to the *poison of serpents*, being applied for this purpose to the bite, as well as taken internally. There is some reason, however, to doubt its efficiency; and, though it may be employed, it should never be relied on to the exclusion of more efficient measures. When taken by accident undiluted, or insufficiently diluted, it produces severe inflammation of the mucous membrane of the mouth, fauces, and stomach, and may even vesicate or act corrosively. The antidotes are the vegetable acids. Much more caution is requisite in applying this to the nostrils, in order to revive fainting persons, or to rouse from positive syncope, than the carbonate, in consequence of the causticity of the vapour. Several instances of severe inflammation of the air-passages are on record from this cause, some of which proved fatal. In one of the instances, the vapour of the ammonia was inhaled as an antidote to hydrocyanic acid. The dose is from ten to thirty drops, which should be given in one or two fluidounces of water.

Water of ammonia, much diluted, has recently been employed externally, with a view to constitutional effect, by Mr. John Grantham, of Kent, England, with great apparent advantage in certain cases. The affections in which it seemed to be most efficacious were *purpura hæmorrhagica*, with internal hemorrhages from various points, and of a most serious character, and *scarlatina* with great general depression; but the remedy is probably applicable to all cases of low disease connected with a morbid state of the blood. He applies, over the whole surface of the body, by means of a sponge, a mixture of from one and a half to two fluidounces with two quarts of water, heated to 120°. (*Med. Times and Gaz.*, May, 1860, p. 521.)

2. SPIRIT OF AMMONIA.—SPIRITUS AMMONIÆ. *U. S.*

This is a solution of gaseous ammonia in officinal alcohol, and differs, therefore, from the last-mentioned preparation only in the menstruum. It has about the same proportion of ammonia as the watery solution, and consequently about the same strength. It may be used for the same purposes, and requires the same caution. The dose is from ten to thirty minims in one or two fluidounces of water.

3. AROMATIC SPIRIT OF AMMONIA.—SPIRITUS AMMONIÆ AROMATICUS. *U. S., Br.*

As now directed in the U. S. Pharmacopœia, this is simply a solution in alcohol, in fixed proportions, of carbonate of ammonia, water of ammonia, and the volatile oils of lemons, nutmeg, and lavender. The British formula differs in submitting the same ingredients, the oil of lavender excepted, to distillation. The proportion of water of ammonia is sufficient to convert the officinal carbonate used, which is a sesquicarbonate, into the neutral carbonate.

The spirit of ammonia has an agreeable pungent odour, and the peculiar taste of ammonia pleasantly qualified by that of the aromatic oils. Upon the system its effects are the same as those of the officinal carbonate of ammonia, and it may be employed for the same purposes. The use of it, however, is generally confined to cases in which its influence as a stomachic stimulant, or slight excitant of the nervous system is wanted. Hence, it is given to obviate *nausea and vomiting* in debilitated states of the stomach, to relieve *flatulence and flatulent pains*, and to correct *gastric acidity*, and the *heartburn* and *sick-headache* which frequently attend it. *Languor*, *faintness*, and the slight *nervous disorder* incident to *hysteria* are often relieved by it; and it is occasionally used to remove the lighter symptoms of *intoxication* caused by alcoholic drinks. It is a good addition to saline cathartics in weak conditions of the stomach. The dose of it is from half a fluidrachm to a fluidrachm, in a wineglassful of water.

IV. PHOSPHORUS. *U. S.*

Preparation. This is obtained by first decomposing the phosphate of lime, contained in calcined bones, by means of dilute sulphuric acid, and afterwards decomposing the excess of phosphoric acid in the superphosphate thus procured, by heating the latter with charcoal, which takes the oxygen of the acid, and escapes as carbonic acid, while the phosphorus distils over, and is received under water, where it hardens.

Properties. As usually kept in the shops, phosphorus is in cylindrical sticks, of a light-yellowish colour, translucent, tasteless, of an odour like that of garlic, quite insoluble in water, very slightly soluble in alcohol, of which a fluidounce dissolves only about a grain,* and considerably more soluble in ether, chloroform, and the fixed and volatile oils. In the absence of air, it melts and is volatilized by heat. It is extremely inflammable, taking fire at 100° Fahr., or with slight friction at ordinary temperatures, and sometimes when held between the fingers without friction. Exposed to the air at common temperatures, it undergoes a slow combustion, emitting white fumes, which shine like flame in the dark. Hence, it must be kept under water; but, even thus protected, it appears to unite with the absorbed oxygen of the water, as it is asserted to impart active properties to the liquid. Phosphoric acid results from its rapid, phosphorous acid from its slower combustion. To the latter it no doubt owes its alliaceous smell.*

---

* M. Labarraque supposed that alcohol might dissolve a grain and a half to the ounce (*Dict. de Mat. Méd.*, Mérat et De Lens, v. 277); and Dr. Boling, of Montgomery, Alabama, found that an ounce would dissolve a grain, or possibly a little more.

Effects on the System. Phosphorus is generally admitted to be irritant to the stomach, and powerfully stimulant to the system, especially to the circulation. It is said also to stimulate the nervous centres, strongly to excite the sexual appetite, and to promote the secretions, especially those of the skin and kidneys. Its stimulant action is highly diffusible, operating promptly and but for a short time, so that to sustain its effects, the dose must be frequently repeated.

When given in moderate medicinal doses, it is said to occasion a feeling of warmth in the stomach, to increase the frequency and fulness of the pulse and the heat of the skin, to invigorate the mental functions and muscular power, to stimulate the sexual organs even to priapism in the male, and to act more or less energetically as a sudorific and diuretic. It is asserted that the urine sometimes becomes phosphorescent, and that a garlic odour may be perceived in the breath. When an oleaginous solution of phosphorus is thrown into the veins of an animal, the expired air becomes luminous in the dark, showing that phosphorus is eliminated by the lungs; and, if the animal be killed and examined, these organs are everywhere congested, and spots of yellowish hepatization are found here and there. (Cl. Bernard, *Med. T. and Gaz.*, April, 1860, p. 390.)

Given more largely, it often causes burning pain in the stomach, vomiting, purging, and great epigastric tenderness; and, in its highest degree of action upon that organ, gives rise to severe inflammation, and sometimes even to gangrene and perforation. Upon the system at large the poisonous action is said, after great excitement, evinced by a rapid pulse, heat of skin, headache, giddiness, sometimes delirium, pains and cramps

---

(*N. Orleans Med. and Surg. Journ.*, x. 786.) Dr. Crawford, however, of N. Orleans, found that *absolute alcohol* dissolves two grains to the fluidounce. (*Med. Times and Gaz.*, Feb. 1859, p. 222.)

* It is an interesting fact, in relation to phosphorus, that its slow combustion in the air is entirely prevented when the air is impregnated with the vapours from tar. The same effect is produced even more rapidly by several of the volatile oils, as those of mint, lemons, and turpentine, and by the vapours of benzine. (*Journ. de Pharm. et de Chim.*, 3e sér., xxxix. 331 and 414.)—*Note to the third edition.*

in the extremities, paralysis in different parts of the body, and various other symptoms, to be accompanied with convulsions and insensibility before death. A jaundiced hue of the surface has often been noticed. The probability, however, is that, in most fatal cases, the result has been attributable to intense inflammation or disorganization of the mucous membrane of the stomach. The quantity capable of causing death is exceedingly variable. Löbelstein Löbel asserts that he has seen poisoning produced in a maniac twenty-five minutes after the administration of one-eighth of a grain in substance (*Mérat et de Lens*, v. 281); Dr. Christison mentions an instance of fatal result from one grain and a half; while Dr. Pereira once administered sixteen grains to Chabert, famous as the *fire king*, without any injurious consequences. (Pereira, *Mat. Med.*, 3d ed., p. 332.) In certain cases of fatal poisoning, putrefaction is said to have been singularly retarded. (*Arch. Gén.*, 5e sér., p. 374.)

A slow poisoning results from long exposure to the fumes of phosphorus, as in the manufacture of lucifer matches. The operation of the poison is said to be first experienced, occasionally at least, in toothache and caries of the teeth; but necrosis of the jaws is the ultimate and characteristic effect. This has been ascribed by some to the direct action of the fumes upon the bone through the teeth; but it is scarcely possible that an acrid substance should act so powerfully from without, and yet exhibit no effect on the soft parts; and phosphoric acid, which has been conjectured to be the agent, does not act similarly upon those exposed to the air of factories impregnated with it. Besides, the disease of the jaws is not the only effect. Sallowness of the complexion, bloated face, a dull expression of the eye, and gastric derangement have also been noticed; and a case is on record in which copious inhalation of the vapour produced various functional derangement, ending in failure of the sexual functions, paralysis, and death in three years. (*Arch. Gén.*, Feb. 1853, p. 219.) The probability is that the fumes of the phosphorus, consisting either of phosphorous or hypophosphorous acid, enter the circulation through the lungs, and act specifically on the jaws, as mercury does on the gums.

The fumes of phosphorus are said to be locally irritant to the mucous membranes of the eye and the air-passages, and to have produced serious inflammation in the latter. When phosphorus is burned in contact with the skin, it sometimes leaves a peculiarly troublesome and obstinate ulceration behind it, as I have experienced in my own person. This has been ascribed to the irritant properties of the phosphoric acid remaining in the wound.

Mode of Operation. Phosphorus itself, unchanged, is probably quite inert. Its entire insolubility, the perfect impunity with which it can be handled, and its want of taste when quite clean, are evidences to this effect. Its whole influence probably depends on changes which it undergoes in the stomach, or in the blood after absorption.* In relation to its direct influence on the gastric mucous membrane, it may be supposed to produce its simple excitant effect through some one of the acids resulting from its oxidation, and when it is taken very much divided in solution, the probability is that it is mainly the phosphorous acid which is produced, and which acts. This is of course conjectural; for we do not know the precise effects of that acid when given in substance. It may be that the heat evolved by the slow oxidation of the phosphorus may have some effect in producing the excitation of the mucous membrane. But, in relation to its violent and poisonous action on the stomach, to the high inflammation, corrosion, and gangrene which have sometimes resulted, I am among those who ascribe them to the active combustion of the phosphorus.† This takes fire at 100°, and the heat of the stomach probably is equal to that degree or above it. Atmospheric air is often contained in the organ. These then are the two requisites for combustion; and it is probable, whenever phosphorus is swallowed in the solid state, and comes into contact with the air, that it takes fire. Thus we can explain why it is that, when serious accidents have occurred, it has generally been from phosphorus taken undissolved. Hence too the great uncertainty in its poisonous effects. It may be readily understood that a grain, or even a small fraction of a grain, taking fire in contact with the surface of the stomach, may produce fatal disorganization; while sixteen grains may be swallowed with impunity, if shielded from the air, or if no air is present.

The effects on the system are almost certainly the result of absorption. That in one form or another the phosphorus enters the circulation, is proved by the alliaceous odour of the breath, and, as has been asserted, of the blood. It is probably in the state partly of phosphorous acid, and partly of phosphoric acid, that it is taken up. The odour of the breath would seem to indicate the former, the excess of phosphates in the urine the latter. It is not impossible that the phosphorus itself, in the state of solution, or in that of vapour (see *note*, p. 571), is also absorbed; and the fact must be admitted, if it is true that the urine sometimes becomes phosphorescent under its use.* It is not impossible that the poisonous effects of the absorbed phosphorus may be owing to its combustion in the blood. This supposition is favoured by the fact that phosphoric acid, given to dogs in much larger doses than that in which phosphorus proves fatal, has evinced no poisonous effect. (T. B. Groves, *Pharm. Journ. and Trans.*, xvii. 510.)

---

* Recent experiments by M. Blondlot prove that phosphorus slowly rises in vapour at 104° F.; and as this is but little above the ordinary interior temperature of the body, it is not improbable that the phosphorus may be volatilized in the stomach, and that it is really in the state of vapour that it is absorbed. (*Journ. de Pharm. et de Chim.*, Nov. 1866, p. 323.)—*Note to the third edition.*

† Strongly confirmatory of this opinion is the fact, ascertained by Orfila and Rigaut through experiments on dogs, that phosphorus, in the allotropic state denominated red phosphorus, is wholly destitute of poisonous properties. (*Ann. de Thérap.*, 1857, p. 284.) Now this variety of phosphorus does not undergo combustion at ordinary temperatures, and consequently will not take fire in the stomach. It is true that its want of poisonous properties may be ascribed to the non-production of phosphorous acid by its oxidation. But it has been ascertained that it really does undergo a slow oxidation at ordinary temperatures. (*Jahresbericht*, 1857, v. 46.) Consequently its harmlessness is fairly ascribable to its incombustibility. (*Note to the second edition.*)

If phosphorus should have been taken in dangerous quantities, it should be immediately evacuated by an emetic, with copious draughts of mucilaginous drinks to envelop the poison, and keep it as much as possible from the action of air in the stomach; magnesia being at the same time given to neutralize any acid which may have resulted from its oxidation. Should symptoms of inflammation or corrosion remain after the evacuation of the poison, they must be combated by the ordinary methods, such as leeches followed by emollient cataplasms to the epigastrium, mucilaginous drinks, or opiate enemata; while one of the alkaline bicarbonates may still be exhibited to neutralize any acid that might remain. It has occurred to me that, should a piece of solid phosphorus be swallowed, the free use of carbonic acid water, with bicarbonate of soda in solution, might be useful until the poison could be evacuated. The carbonic acid evolved from the liquid by the heat of the stomach would fill its cavity with a gas, which not only does not support combustion, but, mingled largely with atmospheric air, suppresses the supporting power of it also; while the alkaline bicarbonate would neutralize any free acid present, and still further increase the atmosphere of the acid gas. It has been recommended to wash the burns produced by inflamed phosphorus on the surface with an alkaline solution, in order to remove the phosphoric acid.

Therapeutic Application. The use of phosphorus as a medicine takes date from the middle of the last century. Though now little employed, in consequence of its frequently violent effects, it has at different times and by different persons been used in a great number of diseases; and, properly guarded, is probably capable of useful therapeutic application. *Nervous diseases*, acute and chronic, as *epilepsy, palsy, catalepsy, hypochondriasis, functional apoplexy, tetanus, periodical headache, venereal exhaustion*, and *amaurosis; intermittent fevers; smallpox; vari-*

---

* Though, as stated in the text, the free oxidation of phosphorus in the stomach is probably owing to its combustion, yet it appears to be capable of rapidly and fatally poisoning the system through absorption also; as this effect has resulted, without any decided stomachic symptoms during life, or any evidence of material derangement of the mucous membrane of the stomach after death. (See *Am. Journ. of Med. Sci.*, N. S., xxxv. 288.)

ous other febrile diseases of a low or malignant form; retrocedent eruptions; hemorrhages; different forms of gout and rheumatism; cholera, diarrhœa, and *colica pictonum; chlorosis* and *amenorrhœa; sterility* and *impotence;* and even the *phlegmasiæ,* as *typhoid pneumonia, catarrhal croup, chronic pleurisy,* and *bronchitis,* have been enumerated by authors among the diseases in which phosphorus has been employed and recommended.

A sound discretion, however, would select, from this list, the affections in which its known powers might justify its use. The *collapse* which takes place in the *early stage of certain fevers;* great *prostration* occurring in the course of *febrile diseases* generally; the *alarming depression* sometimes attendant upon the *retrocession of scarlatina, erysipelas,* etc.; in short, all low states of the system requiring prompt and powerful stimulation, and in which ordinary stimulants fail; these afford the conditions under which the practitioner would be justified in having recourse to this energetic remedy. In cases, too, of morbid depression of the generative powers, whether in the male or female, it would appear to be indicated, through one of the best established of its physiological properties. It may, moreover, be tried in *old and very obstinate rheumatic and paralytic cases,* when no discoverable organic lesion renders any amelioration altogether improbable.

Administration. With proper caution in its use, no serious danger need be apprehended. *In the first place,* it should never be given in the solid or undissolved form, not even in a state of mechanical division, however minute. It should be exhibited in solution; and, happily, its different menstrua take up so small a portion of it, that it is brought into contact with the stomach in an extremely diluted state, and the combustion of its particles, should this take place, could do little or no injury.* *In the second place,* it should not be administered when the stomach is quite empty, unless accompanied with copious nutritive or enveloping material, which would secure the mucous surface against its concentrated effect.

---

* M. Tavignot, however, who has used phosphorus very extensively, affirms that the pilular form is preferable for internal use; being perfectly safe, as he prepares the pills, and much more acceptable to the patient. He first dissolves one decigramme (1.5 grain) of phosphorus in eight grammes (about two drachms) of sweet almond oil, with the aid of a water-bath, and then with eight and a half grammes of butter of cacao, and eighteen grammes of marshmallow, forms a mass, which he divides into one hundred pills. To a child from three to seven years old he gives at first one, and then two pills daily. It will be noticed, however, that even in the pill of M. Tavignot, the phosphorus is really in solution, so that the direction in the text still holds good. M. Tavignot affirms that, in the quantity of four milligrammes (0.060 grain) daily, phosphorus may be given for months without the least danger. He also uses it externally in the form of a liniment, made by dissolving, with the aid of a water-bath, one part of phosphorus in four hundred parts of sweet almond oil, and one hundred parts of naphtha. This is applied by friction, and afterwards by means of flannels impregnated with it. He uses the pills and the liniment conjointly. (*Ann. de Thérap.*, 1866, p. 100.)—*Note to the third edition.*

Very different opinions have been advanced as to the suitable dose. A mean between the extremes would give one grain during the day, in divided doses, frequently repeated. The only suitable preparations are solutions in ether, chloroform, olive or almond oil, or some analogous menstruum. Ether and olive oil each dissolves about four grains to the fluidounce. Objections to the former menstruum are the length of maceration necessary, which renders extemporaneous preparation difficult, and the great liability to the loss of the ether, and the consequent precipitation of the phosphorus, when the solution is kept. The solution in oil is preferable, as it is made more speedily, and keeps better. It is prepared, according to the Prussian Pharmacopœia, in which it is designated as *Oleum Phosphoratum*, or *Phosphorated Oil*, by putting twelve grains of phosphorus, minutely divided, into a fluidounce of almond oil, melting the phosphorus by means of a water-bath, and then agitating until solution seems to have been effected. As the oil really dissolves but four grains, the undissolved portion should be separated by decantation or filtration. This oil should be phosphorescent when exposed to the air. The dose of it is from five to ten drops, which may be repeated, in cases of urgency, every half hour; in ordinary cases of debility, every hour or two through the day. It should be given in emulsion with one of the aromatic waters, so made that a tablespoonful may contain a dose of the phosphorus. Dr. R. M. Glover proposes chloroform as a solvent. This dissolves one-fourth of its weight of phosphorus, and has the advantage that the solution is not inflammable. (*London Lancet*, Jan. 8, 1853, p. 34.) The preparation should be made extemporaneously, in consequence of the great volatility of chloroform. One minim of a saturated solution, mixed with fifteen minims of ether and half a fluidounce of wine, might be given, in acute cases, every two or three hours. Dr. Glover also proposes a solution of phosphorus in cod-liver oil, containing half a grain to the ounce, for use in scrofula. (See *U. S. Dispensatory.*)

CLASS II.

NERVOUS STIMULANTS.

Syn. *Antispasmodics.*

THIS class of medicines is characterized by the property of stimulating the nervous system generally, without specially acting on the brain. Most of them are also more or less stimulant to the circulation, increasing the frequency of pulse and heat of skin, and often exciting the secretory functions; but these properties are incidental, and not essential to them as a class; and some, as coffee and tea, are nearly or quite destitute of them. Their peculiarity is simply that they stimulate the nervous centres generally and equably, without concentrating their force upon upon any one or a few of these centres; and the possession of this property would of itself be sufficient to entitle any medicine to a place in the class.

It is this universality of their action that distinguishes them from the following class, or that of cerebral stimulants. As one of the nervous stimulants may superadd to its own characteristic property that of the arterial stimulants, so may it also possess additionally the peculiar influence of the cerebral stimulants, only that its own action would in that case be swallowed up or overwhelmed in this more powerful influence; and such really appears to be the case with some of the nervous stimulants. Thus, while assafetida, valerian, coffee, tea, etc., can scarcely be made to evince, in any quantity, or by any mode of administration, a peculiar tendency to operate on the cerebral centres beyond others, some medicines, much used and very efficient as nervous stimulants, if given more freely than is necessary for the exertion of their influence in this way, not only operate on the brain specially, but do so with great energy; as is the case with ether, camphor, and opium, which, in small doses, produce all the effects of the present class. The only difference between these two sets of nervous stimulants is that, while both, in certain doses, stimulate equably the general nervous system, the former cannot be made to operate specially on the brain, and the latter can be made so to act by simply increasing the dose; that is, in small doses they appear to operate diffusively and equably, and in larger, besides this general impression, superadd a special one upon the brain, which quite covers, if it does not supersede the first. In order to avoid unnecessary repetition, I shall treat of these latter remedies exclusively with the cerebral stimulants; as their most important therapeutic uses would attach them to that class; and it will be easy to point out their applications as nervous stimulants, when they are considered individually. Ether, camphor, and opium, therefore, will be found among the medicines of the next class.

The medicines here denominated nervous stimulants are generally called *antispasmodics* in therapeutic treatises, in consequence of the property of relaxing spasm, which they certainly possess under favourable circumstances, in a very high degree. But spasm depends on so many causes, and is associated, as an effect, with so many different pathological conditions, that the number of remedies applicable to its relief would scarcely fall short of the whole therapeutic catalogue. Dependent often upon inflammation, it may be treated advantageously by all the means which prove useful in the latter affection; that is, by most of the evacuants, revulsives, sedatives, and alteratives; in other instances, having its origin in debility, it will yield to astringents, tonics, and stimulants; and, in a third set of cases, being excited or sustained by various diseases in the different organs and functions, it must be encountered by measures calculated to restore the affected organ or function to health. Again, this class of medicines is by no means confined, in its therapeutic agency, to spasmodic diseases. It is equally effectual in numerous other nervous disorders, to which more particular reference will be made directly. The nervous stimulants are but a very small section of the great host of antispasmodics, while they are themselves much more than mere antispasmodics. The name, therefore, being, in one sense, much too comprehensive, and, in another, scarcely in a less degree too restricted, should be abandoned, with other titles of a similar therapeutic origin, as the antiphlogistics, antiscorbutics, antisyphilitics, etc., which it has been found impossible to retain in any well-considered pharmacological classification. I have proposed a name for the class which simply expresses one of their most prominent properties, and the one for which they are most used in medicine.

1. *Effects on the System.*

It has been already stated that most of these medicines stimulate the circulation, and consequently increase the temperature of the surface. Indeed, this effect is often more obvious in health than their influence over the nervous system. The latter is so diffusive that the balance of the functions is little disturbed; and, no one being prominently affected, there is no striking departure from their healthy condition. Yet some influence upon the nervous functions may almost always be observed. A feeling of cheerfulness, a gentle exhilaration of the spirits, greater vividness of the fancy and energy of intellect, a disposition and capacity for increased muscular action, and some excitement of the organic functions, which are more or less under the influence of the nervous centres, and particularly the function of secretion, may generally be noticed. In great excess, some of them produce disordered sensations in the head, as feelings of fulness, vertigo, and headache; but very rarely do any of them, not belonging also to cerebral stimulants, occasion delirium, intoxication, or stupor. But in disease their effects are very obvious; the most violent apparent disorder of the nervous functions yielding sometimes promptly to their influence.

They are for the most part highly diffusible, acting quickly, and soon ceasing to act. They differ, however, much in this respect; and some of them continue to operate for a considerable time.

Most of them are either volatile, or contain a volatile principle, which is often highly odorous, and generally disagreeably so to those unaccustomed to it, though it is often rendered tolerable and even agreeable by habit. Many persons acquire a strong relish for the smell and taste of assafetida and garlic.

It has been thought by some that the nervous stimulants produce their remedial effects exclusively, or nearly so, through the organ of smell. I have never been of that opinion. They will often operate energetically when taken in the form of pill so as to conceal their smell and taste, and not unfrequently will produce the most prompt and powerful effects when given by enema. In some instances, they do probably act by an impression made on the nostrils, which is conveyed through the communicating nerves to the nervous centres; but, in general, there can be no doubt that it is through the alimentary canal that they affect the system. In relation to some of the more odorous, as musk, assafetida, and garlic, the odour which they impart to the exhalation from the lungs and skin, is an incontestable proof of their absorption; and the strong probability is, in reference to all of them, that the active principle enters the circulation, and is carried with the blood to the parts upon which it is to operate. When their volatile principle is inhaled into the lungs, it finds a ready entrance into the circulation; and some of the class, when applied externally, are absorbed with considerable facility; as is certainly the case with garlic, and probably with assafetida.

2. *Therapeutic Application.*

The special application of this class of medicines is to the relief of nervous disorder. They are used in all affections of this kind, whether the result of over-excitement, or of depression of the nervous centres, provided only they are purely functional; that is, unconnected with active congestion or inflammation, or any other organic disease in those centres. This may at first sight seem singular; that the same remedy should prove useful in morbid excess and morbid deficiency of action; but the apparent anomaly is not insusceptible of explanation.

The characteristic effect of these medicines is to stimulate the nervous centres. It will, therefore, be readily conceded that they may prove serviceable in disease, consisting in a depressed state of the nervous functions. But how can they, by their stimulating power, relieve a disease, consisting essentially in an already morbidly excited condition of the parts upon which they act?

To answer this question, we must admit, as a starting point, that there is only a limited amount of nervous excitability in the system; in other words, that, taking the whole nervous system together, it is insusceptible of unlimited exaltation, and that there is a point beyond which its actions cannot be elevated. Again, it must be admitted that the nervous energy is transferable, like the blood, from one part to another; that an over-excitement in one or more parts will call it off from others; and that in health there is a general tendency to an equilibrium of distribution. By supposing the existence of a nervous fluid, this reasoning might, perhaps, be rendered somewhat more intelligible; but I avoid this advantage, as the existence of such a fluid has not been proved; and the argument is equally cogent without it. Admitting the above propositions, which I believe are nothing more than statements of facts susceptible of satisfactory demonstration, we have only further to recollect, that the nervous stimulants are characterized by the universality and equability of their action on the nervous centres. Suppose now that one of the cerebral centres is irritated into diseased action, which exhibits itself in spasms of the muscle directly connected with and dependent on that centre. A nervous stimulant is administered. It of course excites all the centres, operating on the one diseased in the same degree as on the others. Each becomes the seat of an attractive effort calling to itself as much of the nervous power as may correspond with the degree of excitation applied. All, therefore, draw with a united force upon the surplus in that one centre, in which there is supposed to be a morbid accumulation. To this united force it can oppose only its own attractive force, under the irritation to which it is exposed. If, therefore, the combined excitation applied to the nervous centres generally, is not less than that existing in the one diseased, under the morbid irritation, united to the excitation of the remedy, which it shares equally with the others, it must part with its surplus, and be reduced to the general level, or near it If the causes of irritation shall have ceased, and the disordered centre be continuing to act morbidly simply from having begun to do so, the equilibrium can be entirely restored, and the disease cured. If not, the equilibrium is but partial or temporary; and the disease, though relieved, will be liable to return. The nervous stimulants, therefore, though they may afford much relief, even during the continuance of the cause, cannot be expected to effect a cure until this shall have ceased to act.

In former times, these stimulants were said to prove useful by *equalizing excitement*. This term conveys succinctly the idea which I have endeavoured to demonstrate in the above paragraph. Our predecessors could not but notice the effect, though I am not aware that they have attempted a precise explanation. Their notions of the influence of the nervous centres were less definite, probably, than those now prevailing.

Functional nervous disease may be, *in the first place*, idiopathic, or self-existent, and alone; or, *secondly*, it may be idiopathic, and associated with other diseases; or, *thirdly*, it may depend upon other diseases; and each of these conditions has a bearing upon the therapeutic application of this class of medicines.

1. It appears to me beyond dispute that the nervous centres may become originally the special seat of functional disease, as well as any other part of the body, the cause operating on them directly through the same avenues by which they receive impressions in health; and the disease may exist without any complication whatever, other than such as may be induced in the functions under the control of the centre affected. It is to disorders of this kind that the nervous stimulants are peculiarly applicable. Such are, in many instances, the morbid phenomena denominated hysterical. There is here no other disease than that directly produced by causes external or internal, operating strongly upon the healthy centres, or moderately upon centres abnormally excitable. Even during the continuance of the cause, the nervous stimulants will often, by sustaining an equable tension of the nervous force, keep the disorder at bay; but, for a permanent cure, measures must be taken to obviate the cause, when the nervous centres are not in fault, or to give these a healthful power of resistance when unduly excitable. When the cause has been removed, and the disorder continues, as it often does through a sort of law of continuity in the actions of the system, the nervous stimulants will often remove it like a charm. Thus a female has been thrown into violent hysterical disorder by some exterior influence, slight or severe, as the case may be, which, however, no longer acts; but the disorder continues with little abatement for hours, perhaps for days. In such cases, one of the nervous stimulants, a few doses of assafetida for example, perhaps even a single dose, may put a speedy end to the phenomena.

2. Sometimes the affection, originating as above, may coexist with other diseases originating in different causes. Inflammation of one of the important organs may complicate the hysterical phenomena, and demand a close scrutiny. The danger is that, in the turbulence of the nervous phenomena, the more serious disease may be overlooked. It will be the duty of the practitioner to investigate the case carefully, and, having made the diagnosis, to employ the nervous stimulants altogether in subservience to the measures required by the more dangerous affec-

tion. To go on stimulating with assafetida, ether, camphor, etc., in such a case, under the impression that it is merely nervous, might prove very detrimental, perhaps fatal. Yet, with due attention to the coexisting disease, the nervous stimulants may often be used safely in conjunction with other remedies, and even beneficially to the more serious complaint, by preventing the injurious reaction of the nervous disorder upon it.

3. More frequent than either of the preceding categories, is that in which the nervous disorder merely complicates some other pathological condition, which has called it into existence and sustains it. In such cases, much injury has been done by overlooking the real disease, and addressing remedies to the more obvious and apparently violent nervous phenomena. It has been too common to treat them by the nervous stimulants chiefly or exclusively, and to persevere long with such treatment to the unspeakable injury of the patient. The practitioner should be always on his guard against this easy mistake, and never rest satisfied, in the treatment of nervous diseases which may be at all obstinate, until he has traced them satisfactorily to their cause. Judicious measures now employed will often put an end to an affection, which may have been torturing the patient, and embarrassing the practitioner, for months, perhaps for years. We have not space here to specify the several morbid conditions which may thus give rise to nervous disorder. The consideration of them belongs to treatises on the practice of medicine. My object here, in noticing them, has been to complete a view of the circumstances which should regulate the use of the nervous stimulants. I would merely call attention to the stomach and bowels, the liver, the urinary organs, and in women the uterus, as the frequent seats of disease exhibiting itself in various nervous disorders; and to an anemic state of the blood, as one of the most prominent and efficient causes of the same affections. This impoverished state of the blood may act doubly. It directly weakens the nervous centres through the want of material for their support; while the insufficiently supplied functions of the system generally, by their unceasing calls upon the nervous centres of circulation and respiration to supply them with more and better blood, maintain in these centres a high degree of irritation, leading to diversified nervous disorder. Now the indications, in all such cases, is to address remedies especially to the original disease, and to employ the nervous stimulants simply as adjuvants, in order to suppress any occasional excess of nervous derangement, and to prevent its injurious reaction upon the organs or the system.

In the use of this class of remedies, the practitioner should also bear in mind the general rule in relation to all stimulants; that the system becomes habituated to them by constant use, and thus, after a time, almost ceases to feel their influence, unless exhibited in constantly increasing quantity. They should, therefore, seldom be employed continuously for any great length of time. Hence, in persistent, and especially incurable organic diseases, the nervous stimulants are of doubtful utility, and should be used rather to correct occasional disorder, than to sustain a permanent impression.

This class of medicines is contraindicated in inflammatory and febrile diseases, when the state of the system is sthenic, and the blood rich and abundant. Simple fever, or even inflammation, does not always forbid their use; on the contrary, when the blood is impaired in those cases, and a tendency to a low condition is observable, or even in the mere absence of the opposite condition, they may often be used advantageously in relieving attendant nervous disorder. They are especially contraindicated, when high congestive irritation, positive inflammation, or organic disease, such as hemorrhage, tumours, etc., occupies the nervous centres themselves.

To the severest nervous diseases, or those which are deeply radicated in the cerebral or spinal centres, the nervous stimulants, as such, are inapplicable. Apoplexy, epilepsy, insanity, palsy, tetanus, profound coma, and even convulsions, other than those of a comparatively light character, are beyond their control. They may occasionally be used as adjuvants in such affections, when not contraindicated; but should not be relied on.

Before closing these general observations, it will be proper to give a brief view of the different nervous affections, or rather forms of nervous disease, in which this class of medicines is employed.

Preliminarily, I would call the attention of the reader to the admitted fact, that depression and over-excitement or irritation of the nervous centres are attended, to a considerable extent, with the same phenomena. How this may happen I have endeavoured to explain in my treatise on the Practice of Medicine. The circumstance is practically of little importance as concerns the use of the present class of medicines; for they are applicable, as already explained, to both these opposite conditions, except, in reference to irritation, when it is attended with active congestion or inflammation in the centre itself, or its immediate vicinity; but the view which the practitioner may take of the pathological condition, whether one of exaltation or depression, will very much influence the coincident treatment.

The nervous conditions or affections requiring the use of the nervous stimulants may be arranged under the following heads.

1. *Morbid Excitability of the Nervous Centres.* This is a morbid condition, not a deranged action. The patient may possess it, yet, in the absence of any excitant agency, may appear perfectly well. The condition, however, is on the brink of disease, into which the slightest impulse may precipitate the system. It is often the result of a luxurious

and easy life, with sedentary habits, and a feeble restraint over the various propensities, moral, sensual, or physical, which belong to our nature. Some, by their original constitution, inherited or accidental, have a tendency to it. Such persons are said to have a nervous temperament. Women, by their very nature, are more subject to it than men; because, having a great additional function to perform, beyond what belongs to the other sex, for the preservation of the species, they require more impressible nervous centres, so that all parts of the double existence may be brought into a due relation, by a ready perception of their mutual wants. On the same principle, to a certain extent, children are more excitable than adults. The rapid growth of their systems requires a quick impressibility of their nervous centres, in order to preserve a proper balance of the functions. Hence, in all these classes, nervous diseases are more common than in others. It is true, that the nervous stimulants have little effect in correcting this morbid excitability; but they may be occasionally used advantageously to guard against positive disorder, under circumstances of necessary exposure. The cure of the condition must depend upon a removal of its causes, and the employment of measures calculated to invigorate without exciting the system.

2. *Spasmodic Affections.* These are extremely numerous, and, whenever dependent on mere depression or excitement, without active congestion of the nervous centres, may be treated advantageously with the nervous stimulants. These medicines are equally efficient, whether the spasm occupies the voluntary muscles, the involuntary, or those partaking of the character of both.

Of the first, or that seated in the voluntary muscles, we have examples in *subsultus tendinum*, *cramps* or *painful spasms* of particular muscles, and *clonic spasms* or *convulsions*, sometimes confined to the muscles of one or a few parts of the body, and sometimes more or less general. In the first and last of these kinds of spasm, the nervous stimulants are more efficient than in the intermediate. This generally depends on an amount of irritation either in the nervous centres or other part, which is in most cases beyond the reach of these medicines. For example, the spasms of tetanus, the external cramps of cholera, and even ordinary cramps in the limbs, are little influenced by the nervous stimulants, given in their proper capacity. Such of them as have narcotic properties are often serviceable, when carried to the point of narcotism.

Among the spasmodic affections of the involuntary muscles are *cramps of the stomach and bowels*, *gall-ducts*, *ureters*, and *bladder*, and *spasm* of the *bronchial tubes* as in *asthma*, of the *œsophagus*, and, in women, of the *uterus* and *vagina*. There are none of these, when dependent on mere functional disorder of the nervous centres, whether spinal or cerebral, which may not be benefited by the nervous stimulants. But they are often produced by local causes, and associated with inflammatory conditions, which contraindicate the medicines of this class.

Of spasm in the mixed voluntary and involuntary muscles we have examples in the diaphragm, as in *hiccough*, which generally yields to the nervous stimulants, and in *painful spasm* or *cramp*, which may often be benefited by them, but often also requires more powerful remedies; in the muscles of respiration generally, as in *hooping-cough*, which is much alleviated, but seldom or never cured by them; and in the muscles of the glottis, as in *laryngismus stridulus* and *catarrhal croup*, the former of which is often benefited by them, the latter seldom.

3. *Irregular Movements of the Voluntary Muscles, not Spasmodic.* Of this kind are *general restlessness, jactilation, aimless muscular motions, whimsical gesticulations, imitative or suggestive movements but half voluntary, hysterical laughter, sobbings, facial distortions, hurried respiration, violent coughing*, etc., all of which are often happily controlled by these remedies.

4. *Disordered Sensation.* This is extremely frequent, and of a character more or less amenable to nervous stimulation. Examples of general disorder of this kind are presented in *malaise* or *uneasiness, fidgetiness, weariness, lassitude*, and *soreness;* and of local disorders an infinite variety, as *tingling, itching, prickling*, etc., in the skin and other parts; *neuralgic pains*, which may occur almost anywhere; *headache, giddiness, dizziness, weight, tension, fulness*, etc., of the head; *buzzing, roaring, hissing, whizzing*, etc., in the ears; *sparkling, flashing, perverted colouring, double vision, muscæ volitantes*, etc., in the eyes; *false odours* and *perverted tastes;* feelings of *want of breath, weight, tightness, oppression, suffocation*, etc., in the chest; *constrictive globus hystericus* in the throat; and, in the stomach, bowels, and other abdominal and pelvic viscera, numerous and diversified feelings of uneasiness, which are too vague to be described, or to have been named.

5. *Diminution or Loss of Muscular Power or Sensation. Dimness of vision, hardness of hearing, loss of articulation, aphonia* or more or less complete loss of voice, *paralysis* of one or more of the voluntary muscles, *incontinence of urine and feces, constipation* and *tympanites* from suspended peristaltic movement, are examples of nervous disorder, which, though frequently dependent on affections quite beyond the influence of the nervous stimulants, are sometimes purely functional, and yield more or less to their influence.

6. *Mental Disorder.* Under this head may be placed *depression* or *false elation of spirits, hysterical fancies* and *emotional perversions, brief delusions, hypochondriasis, hysterical insanity*, and the *delirium of cerebral exhaustion*, as in low typhoid fevers and proper delirium tremens. *Obstinate wakefulness, untimely drowsiness, lethargy, disturbed sleep, nightmare, uneasiness or whimsical dreaming, somnambulism, long-continued hysterical insensibility*, may be placed in the same category.

7. *Derangements of the Organic Functions.* These embrace every conceivable disorder of every function, whether increase, diminution, or perversion, provided only that it do not result from inflammation or organic disease; for all these functions are more or less under the control of the nervous centres. I shall not pretend to enumerate them; but a brief notice of a few of them may serve to give the student some idea of their nature. In relation to the lungs, there is *dyspnœa* and *asphyxia;* to the heart, *palpitations* and *faintness,* or *positive syncope;* to the stomach, *nausea, vomiting, eructations, flatulence, loss of appetite, morbid craving,* and desire for strange articles of food or medicine; to the bowels, *borborygmi, diarrhœa,* and *constipation;* to the kidneys, *excessive limpid diuresis;* and to all other secretory organs, more or less perversion of their office.

Of the recognized diseases in which the morbid phenomena above noticed occur most frequently, and in greatest diversity, and in which they most readily yield, at least temporarily, to the nervous stimulants, *hysteria* undoubtedly stands at the head. Probably *nervous rheumatism* and *gout* come next in order; and the greater number of the phenomena above mentioned are often nothing more than results of disordered function, arising from influences which, ordinarily producing the inflammatory symptoms of those diseases, cause only nervous disorder when they act upon feeble, anemic, or nervous individuals. I have noticed, however, that the functional disorder in these affections, though occasionally much benefited by this class of remedies, does not yield to them so readily as the analogous affections in hysteria. *Chorea, pertussis, spasmodic asthma, nervous cough, hypochondriasis,* and *delirium tremens* are other special diseases in which the nervous stimulants are often indicated, but are generally alone insufficient to effect a cure. *Epilepsy* and *neuralgia* are sometimes benefited by them, but very seldom cured. There are, indeed, few diseases which are not occasionally attended, in certain stages of their progress, or in certain associated conditions of the system, with one or more of the symptoms enumerated, and in which the nervous stimulants are not sometimes indicated.

* * *

There are various remedial influences which act upon the nervous centres in a manner somewhat analogous to the nervous stimulants, and which, not being properly medicines, must be considered in this place. They may be included under the heads of the *emotional* and the *sensational.*

1. EMOTIONAL INFLUENCES.

The excitant emotions may often be usefully brought into play, in depressed or disordered states of the nervous functions. *Hope*, *confidence*, *joy*, *love*, *ambition*, and other analogous states of mind, exercise, within due bounds, a most happy influence, overflowing, as it were from their own special centres, over the whole cerebral and spinal regions, and throughout the sensitive system, diffusing a sort of physical exhilaration, which is admirably adapted to equalize excitement, and raise up the morbidly depressed nervous functions to their healthy level. Their effects are, indeed, closely analogous, in several respects, to that of the purer nervous stimulants. They not only excite the nervous centres, but, through them, increase the frequency of the pulse, diffuse a glow over the frame, and not unfrequently increase the various secretions, including even the menstrual. These are ordinary effects of the class of medicines we are now considering. Another coincidence is the wakefulness which they often occasion in a state of health, while they sometimes produce sleep by quieting the nervous disorder, which prevents it in disease. Like these medicines, also, in excess, they may give rise to vertigo, headache, mental confusion, tremors, etc.; but very seldom, like the narcotics, cause positive intoxication, delirium, or stupor, by their own immediate action.

The methods of bringing their influence to bear upon a patient in any particular case, and the precise circumstances under which they should be resorted to, must be left to the sagacity and judgment of the practitioner. But every one should bear in mind their great efficiency, and be prepared to avail himself of it when the occasion may offer. He should also bear in mind one important rule; to proportion, namely, the degree of the influence wanted to the requisitions of the case, and take care that injury is not done by excess. He must be as cautious not to overdose his patient, in the use of these remedial means, as in that of medicines. *Hysteria*, *hypochondriasis*, and *insanity*, are affections upon which the *medicina mentis* may often be brought usefully to bear. The influence of hope and confidence in favouring the action of other remedies is well known. How often do *neuralgic pain* and even *spasm* seem to yield to means wholly inert, as to the metallic tractors, or the globules of the homœopathist, when the hopes of the patient are strongly excited, or his full confidence gained in the efficacy of the measures used! How often do we see *epileptic convulsions* postponed for months in pure functional cases, or perhaps set aside completely, under the use of remedies from which the patient confidently expected relief, though long experience may have satisfactorily proved their utter worthlessness! *Intermittent fever*, and other periodical diseases, are often interrupted by a conviction inspired into the patient, by whatever means, that he will miss the approaching, or any particular paroxysm. It is well known that successful love has often arrested approaching *insanity*, if it has not proved remedial even after the disease has been established. But it is unnecessary to multiply instances. I have no doubt that the various excitements of *travel*, its anticipations, novelties, surprises, diversified incidents, varieties of scene, and multiplied enjoyment of social pleasures and the beauties of nature and art, contribute, in many cases of nervous disorder, more powerfully to the cure, than any medicine or combination of medicines which could be applied.

Under the same head may also be placed the effects of *surprise*, or other *startling impression upon the mind*, in overcoming *neuralgic pains*, and *morbid mental* or *physico-nervous associations*. One of the most efficient methods of checking mild *singultus* is to startle the patient by a sudden exclamation, or by a declaration calculated to produce quick and strong emotion. The *hysterical female*, or *hypochondriac male*, will be roused out of apparent stupor in the case of the former, or some morbid conceit in that of the latter, by skilfully contrived plans of powerfully impressing their feelings or imagination. *Nervous headache* is often relieved by a sudden and strong diversion of the attention, however effected.

2. SENSATIONAL INFLUENCES.

These may often be so employed as to become powerful means in the cure of various functional disorder. They operate either by a direct excitation of depressed nervous centres, or by revulsively relieving those which are in a state of irritation. There are two sets of them, one acting through the special senses, the other through the general sensibility.

1. *Through the Special Senses.* A sudden *impression on the retina*, as from a flash of sunlight in a dark place, or of lightning in the night, may sometimes rouse a torpid brain, when only functionally affected.

Similar *impressions on the sense of smell* will often check asphyxia; and the disagreeable odour of fetid substances is one of the means by which they relieve nervous disorder.

A sudden *sharp sound* may arrest a threatened attack of syncope; and *blowing in the ear* is one of the remedies recommended for laryngismus stridulus. It is probable that *music* operates remedially, in part, by a moderately stimulant influence on the auditory centres; although something higher than sensation is here also concerned; for sounds arranged melodiously, or in harmony, have associations with our mental constitution, which often powerfully excite emotion, and thus produce nervous stimulation by an additional influence. In calming morbid nervous irregularity or excitement, music is well known to have had extraordinary influence from the times of the Hebrews, when the harp of

David composed the mental distemperature of the Jewish monarch. I was once witness to a striking case of this kind. It was in a stage-coach full of passengers, among whom were two or three women who could sing. A young man was suddenly seized with symptoms of insanity. After having attempted to escape by jumping out of the window of the vehicle, he was seized by the passengers, and compelled to remain. The idea took possession of his mind that he was in the power of robbers, who intended to kill him. He began to scream violently and incessantly; and no assurances, nor anything else that could be done, seemed to pacify him. At length our female companions suggested the effects of music. The suggestion was approved, and they began to sing in concert; entertaining us with song after song with the greatest zeal and good nature. The poor maniac gradually began to show the influence of the music. His cries became less violent, and by degrees subsided into complete calmness; and before the strains ceased he was fast asleep. The music probably acted as a stimulant, calming the perturbation, by bringing the nervous centres to a similar level of excitement, after which they fell into a state of exhaustion consequent on the previous exaltation, and sleep ensued.

There is no doubt that an *excessively disagreeable taste* may operate similarly in rousing the nervous centres of respiration and circulation.

A strong pressure on the upper lip will sometimes enable one to control an otherwise irresistible tendency to sneeze; and a smart slap on the back may surprise nervous spasm of the glottis into relaxation.

2. *Through the General Sensibility.* Smart pain produced by any cause will often relieve nervous disease. Not unfrequently a restless patient may be made to sleep by a pair of blisters to his extremities. I knew a gentleman who was never free from morbid hypochondriacal sensations except when he had a blister drawing upon his epigastrium. The pain produced by a sinapism over the stomach is probably quite as efficient as the revulsive effect of the inflammation, and even more so, in relieving spasm of that organ. But pain may be carried so far as to overwhelm instead of rousing the nervous centres, as we see constantly in violent spasms of the stomach, bowels, ureters, etc. As a remedial measure, therefore, it must be used with discretion. To this category belong the shock produced on the nervous centres by cold and by electricity, each of which merits a brief notice.

Cold as a Nervous Stimulant. Cold operates, in this capacity, solely through the sensation produced by its contact with the surface. Though a depressing agent in its direct action upon the part with which it comes in contact, it yet communicates to the nervous centres an impression, denominated the sensation or sense of cold, which is really excitant. This excitant impression may often be taken advantage of therapeutically to arouse the nervous system generally, or some great function, as the circulatory or respiratory, the nervous centres of which may be prostrated. Cold is applied in various methods, and in various degrees of intensity for this purpose. 1. One of the mildest is by simply *sprinkling cold water* on the face, or dashing it with a slight degree of force by means of the finger. This often answers an excellent purpose in obviating syncope or asphyxia, and will suffice to arouse a patient from slight attacks of this kind. 2. A stronger method, is to *dash it upon the head, back of the neck, and shoulders,* out of a small vessel. This plan may be resorted to in cases of stupefaction from narcotic poisoning, as by opium for example, in which it will sometimes temporarily excite the susceptibility of the brain, and enable it to feel the impression of emetic medicines upon the stomach. Vomiting may thus be induced, which the medicine unaided might be incompetent to effect. In asphyxia from hydrocyanic acid, it is one of the most efficient means of bringing about a return of respiration. One of the first effects of cold, suddenly applied to the surface, is to induce an involuntary inspiratory effort, through its excitant influence on the nervous centre of respiration. This inspiration is what is needed for the recommencement of the vital movements. Air is inhaled, the blood is changed, the pulmonary capillaries, before torpid, carry onward the arterialized fluid, this reaches the heart, and the central organ of circulation, thus reanimated, sends the life-giving current everywhere through the body. If the poison has ceased to act, this simple measure may be sufficient; if not, it at least gives the opportunity for the employment of others more efficient. So also in the asphyxia from chloroform, and other poisons operating in a similar manner. Spasmodic closure of the glottis in hysteria, epilepsy, and laryngismus stridulus may be relieved in the same way; the excitant impression on the nervous centre, which causes the effort at inspiration, operating so as to relax the spasm which would impede the entrance of air. 3. A third and still more energetic method of applying cold for the purpose of a nervous stimulant, is by means of the *cold shower bath.* This may be employed, in cases of mental torpor, to rouse the energies of the brain; but care must always be taken that there is sufficient energy in the system to insure reaction against the immediately depressing influence of the cold on the surface. 4. A fourth method, more energetic as a nervous stimulant than either of the others, is *cold affusion,* or the pouring of cold water, in considerable quantities, from pails, or other vessels, held two or three feet above the body. This was recommended by Dr. Currie, of Liverpool, in fevers, with the view of cutting them short; an object which is effected in some cases of typhus, and possibly in remittents, but never in typhoid or enteric fever. The operation of the remedy is partly by cooling the heat of the surface; but it is mainly by the powerful shock upon the nervous centres, breaking the morbid associations upon which the disease may depend, and introducing a new series of actions which may subside into health. But the measure does not always succeed, and is somewhat hazardous where it does not; and in general there are other and milder means which are in the end probably more effectual. But there is a condition of great danger, in which cold affusion has been employed with much asserted success; and in which, should other measures fail, the practitioner would be justified in having recourse to it. I allude to the condition of collapse sometimes occurring at the commencement of malignant febrile diseases, and often characterizing the onset of *pernicious* or *congestive fever*. The patient in this condition, though really cold both without and within, as shown by the state of the breath, not unfrequently complains of burning heat. The sensation of the cold affusion is said to be agreeable to him at first; and the moment at which he begins to feel an unpleasant sense of chilliness, is the time to cease with the application of cold, and to apply measures requisite for favouring reaction; as wiping him dry, wrapping him up in blankets, etc. The powerful stimulus of the cold to the nervous centres is, under these circumstances, the great agent of restoration. Other affections in which cold affusion has been used are the *collapse of cholera*, *asphyxia from carbonic acid*, and *puerperal convulsions*. In the use of affusion the patient should be stripped naked, and may either have the water poured upon him from above while sitting over a tub; or, what is more convenient, he may be placed horizontally, and the affusion be made from a pitcher from one end of the body to the other. 5. The most energetic method of applying cold as a nervous stimulant is by *immersing a patient in the cold bath.* Generally speaking, this is too powerful for the object aimed at, which can be sufficiently accomplished by one of the other plans. Nevertheless, I have known it to be resorted to in one case of apparently almost fatal prostration in the pernicious paroxysm, with the supposed effect of producing reaction, and saving the life of the patient.

The temperature of the water for these purposes may be from 33° to 60° F., but must vary with the method of application. When merely sprinkled upon the face, it can scarcely be too cold. When dashed moderately on the head or shoulders, or used in the form of a shower bath, it may be at the mean between the two extremes mentioned. When poured from a height over the whole body, or used in the form of a bath, it may be between the mean and the highest temperature. The period of application should always be very short. It is the shock that is wanted, not the depressing influence of the cold. If it be continued too long, the depressing effect will reach even the nervous centres themselves, and a result exactly the reverse of that desired will be obtained. An instant is often enough; and the application should seldom be protracted more than two or three minutes.

Electricity in Relation to its Sensational Effect. In the precise sense in which the remedy is here considered, electricity acts merely by exciting sensation. In regard to its influences in general, it is a universal stimulant, and has been treated of, along with heat, under the general head of stimulation. The various methods of applying it have there been considered. Here we have only to do with the influence of its shock, in other words, with the sensation it excites when applied so as to make a painful impression upon the nervous centres, which painful impression is the source of the remedial influence. For this purpose, it may be applied in two modes, either by the discharge of a Leyden jar, or by rapid intermissions of the current by means of the different coil machines. The latter is the more effective method, as the impression is sustained, and can be graduated exactly to the requisitions of the case. The therapeutic effect aimed at by thus exciting sensation, is to rouse the functions from torpor by the diffusive stimulation which such an impression produces, when not overwhelmingly violent. It is not in the prostration from long-continued disease, or that which often attends the progress and close of febrile and inflammatory affections, that the remedy is indicated. There is here not force enough to sustain the excitement after it has been produced; and a continuance of the measure would only further exhaust the excitability. The cases in which electricity is applicable, upon this principle, are those in which the system has been suddenly prostrated into more or less complete insensibility through impressions on the nervous centres, and in which the excitability remains unexhausted. Such are attacks of syncope or asphyxia, especially after the cause has ceased to act. The cases of poisoning by opium, before referred to (see *page* 537), in which the electro-magnetic machine aroused sensation in the advanced stage, when the direct symptoms of the poison had been followed by great prostration, and in which life appeared to be saved in consequence, are examples of this kind. The apparently comatose state of hysteria is another condition which indicates the use of the remedy. It would, probably, moreover, serve an excellent purpose in some cases of malingering.

I. MUSK.

MOSCHUS. *U. S.*, *Br.*

1. *Origin.* Musk is the product of an animal bearing some resemblance to the deer, usually less than three feet high, with elevated haunches, long and narrow ears, a short tail, and tusks projecting downwards from the upper jaw. It is of various colours, but the most common is a deep iron-gray. The musk is contained in an oval sac, situated

between the umbilicus and prepuce, and opening outwards by a small orifice.

The animal inhabits the mountainous regions of Central Asia, lying between Siberia in the north and the Himalaya Mountains on the south, and comprehending Chinese Tartary and Thibet. It is solitary and timid, preferring the highest and most inaccessible places among the mountains, and seeking its food at night. The natives catch it in snares, or kill it by means of cross-bows set in its paths. Sometimes they also shoot it with guns, or with the bow and arrow. After its death, the bag is cut off and dried.

The musk of commerce is brought from two sources; from Siberia, through Russia, and from China, by the port of Canton. The Chinese variety is the best, and, so far as I know, is the only one imported into this country.

The great value of musk leads to its frequent adulteration, and it seldom reaches our shops quite pure. The Chinese open the sacs, remove their contents, which they mix with dried bullock's blood and other impurities, and then reintroduce a portion of the mixture into the sac, and close the opening more or less carefully. Another portion they inclose in artificial sacs, made from the skin or scrotum of the animal; and it is these latter which are most frequently brought to the United States, according to my own observation. After importation, the contents of the bags are removed, and, as we are informed, undergo another adulteration, in the process of granulation, by which it is prepared for the shops.

2. *Sensible and Chemical Properties.* The true musk sac is oval, between two and three inches long, bare on the side at which it was attached, and covered on the other with coarse hairs, arranged concentrically about a small opening. The sacs commonly imported are of about the same size, but are full and rounded as if stuffed, have a piece of membrane on one side, and a portion of hairy skin on the other, and show clearly where the two pieces have been clumsily sewed together.

As usually kept in the shops, the musk is in irregular grains, soft and unctuous to the touch, of a brown or reddish-brown colour, and frequently mingled with the short hairs of the sac, which appear to have been added to increase the weight. The *smell* is strong, extremely diffusive and permanent, to most persons very disagreeable in its greatest intensity, but usually considered agreeable when slight, and much esteemed in perfumery. So diffusive and so permanent is it, that a small portion of musk will scent the whole atmosphere of a chamber for many days, without losing any appreciable portion of its weight; and the slightest contact with it will give an odour to the person or clothing, which remains for a considerable time. In some very nervous persons, the smell produces giddiness and faintness; and it has been known to throw hysterical women into convulsions. The *taste* is bitter, somewhat acrid, and disagreeable. Musk is inflammable. It imparts its virtues partially to water and alcohol; but neither fluid has been found to act satisfactorily as a menstruum in pharmacy. The active principle has not been isolated. Though musk contains a considerable proportion of matter volatilizable by heat, yet it cannot be deprived of its odour by distillation with water.

Musk will keep for a long time unimpaired in a well-closed glass bottle, in a dry place. It should always have its own strong characteristic odour and taste, a colour neither very pale nor blackish, and an unctuous feel, without grittiness.

3. *Effects on the System.* In medicinal doses, musk produces a feeling of warmth in the stomach, followed by slight cerebral excitement, some increase in the frequency and fulness of the pulse, and a warm softness of the skin, which continue for a short time, and then subside without leaving any unpleasant effect behind. Taken more largely, it is said to disturb the stomach, and to occasion a feeling of weight, giddiness, and pain in the head, with considerable excitement of the circulation, and a tendency to sleep. I have, however, never noticed this last effect. In very large doses, we are told by Jörg, that it causes trembling of the limbs, and sometimes convulsions. It is, then, a moderate stimulant to the circulation, and a powerful stimulant of the nervous system, though possessed of little narcotic power. Trousseau and Pidoux have found it somewhat excitant to the genital organs. (*Trait. de Thérap.*, 4e ed., ii. 218.) It is said also to have sometimes proved diaphoretic and diuretic; which, indeed, may be said of all the stimulants.

Its odorous principle, which is probably also the source of its medicinal activity, is certainly absorbed; as it was noticed by Tiedemann and Gmelin in the blood, and is often strongly perceptible in the urine, perspiration, and pulmonary exhalation.

4. *Therapeutic Application.* Musk was unknown to the ancients, and is said to have been introduced into Europe by the Arabians. It may be used for the general purposes of the nervous stimulants already detailed; and probably exercises their peculiar influence in a higher degree than any other of the class. It would appear to be specially applicable to cases in which severe spasm, or great nervous disturbance, is associated with a prostrate circulation.

Low Fevers. It was formerly much used in *low fevers*, with subsultus tendinum, nervous tremors, and hiccough; and, so far as these nervous phenomena were concerned, it was no doubt useful; but its stimulant powers are inadequate to the demands of such cases, and it is now little employed.

Adynamic Pneumonia. M. Récamier has recommended musk in a certain condition which occasionally supervenes upon pneumonia, and is characterized by the occurrence of delirium, with a general failure of the vital forces, and dangerous prostration. MM. Trousseau and Pidoux have tried it, in similar cases, with favourable results, and are disposed to prize it highly under these circumstances. (*Ibid.*, p. 223.) The condition alluded to is not that debility which attends typhous pneumonia, and may be supposed to depend on a depraved state of the blood. Neither is it that which comes on after the occurrence of the suppurative stage of the disease. It is one in which the nervous power appears to fail at once, and the general powers of the system to give way with it, as happens in sudden attacks of the pernicious state in our remittent miasmatic fevers. The last-mentioned writers have found it to occur in pneumonia of the upper lobe of the lung, which seems to be a preferable seat of the disease in adynamic cases. A few successive doses of musk have been sufficient to raise the patient out of this adynamic state, and to remove the delirium, after which the disease has followed a regular march towards health.

Pernicious Fever. It has been stated that the condition of pneumonia just mentioned was analogous to the pernicious paroxysms which sometimes supervene on miasmatic fever, in which the prominent symptoms depend on vast prostration or disorder of the nervous power. From the experience of the highly authoritative practitioners above mentioned in these pneumonic cases, I would suggest the use of musk in the *stage of collapse* of our *miasmatic pernicious* or congestive fevers, in which the pathological state certainly affords a fair indication for its use. Though less stimulant to the circulation than some of the medicines employed in this affection, it is very powerful in its influence on the nervous centres, which are probably specially in fault. It might be used in conjunction with the other remedies, and certainly, I think, could do no harm.

Gouty Spasms in the Stomach. Dr. Cullen speaks in very strong terms, from his own experience, in favour of musk in gout attacking the stomach; and there can be no doubt of its efficiency in spasmodic cases of this kind, whether retrocedent or original. If the spasm is accompanied with coldness of the skin and depressed pulse, and resists ordinary measures, recourse should always be had to musk, which should be given freely. Cullen recommends it in other cases of retrocedent gout; and, whenever the affection is spasmodic, or purely nervous, and the same depressed condition of the circulation exists, it may be employed with propriety; but it is contraindicated in the internal inflammatory attacks of that disease, and might do serious injury.

Painful Spasms of the Involuntary or Semivoluntary Muscles. In all cases of painful spasm of the muscles of organic life, as of the œsophagus, stomach, bowels, bladder, ureter, and gall-ducts, or of those conjointly of animal and organic life, as of the diaphragm, if attended with collapse of the circulation, and especially when other measures fail, musk may be used as one of the most powerful antispasmodics at command. But, as in the case of gout in the stomach, it must be given freely.

Infantile Convulsions from Intestinal Spasm. The late Dr. Joseph Parrish employed musk in this affection with great success; and, following his practice, I have found it extremely useful in similar cases of a very threatening character. A proper diagnosis, however, is all-important. In many of the convulsive affections of children, with strong determination to the brain, it would be not only useless, but injurious. In the cases referred to, the convulsions are frequently preceded by a sudden stiffening of the body, as if the child were in great pain, and sometimes by a quick piercing scream; and, if the abdomen be examined, it will generally be found more or less tympanitic. These convulsions are also strongly characterized by a sudden return of intelligence after they have ceased, instead of the protracted coma which is apt to follow those in which the brain is actively congested. The effect depends on a sudden impression made on the cerebral centres by the painful spasm of the bowels; and, under the disturbance of these centres, before time has been allowed for the occurrence of vascular irritation, the convulsive movements take place. In many cases the convulsions return frequently, from hour to hour, or even at shorter intervals, and the life of the child is in imminent danger. The musk may be given, in these cases, by enema; two or three grains being administered to children a year old, and repeated every two hours, if necessary.

Hiccough. Within my experience, there is no remedy or combination of remedies so efficacious in hiccough as musk; and, were its only recommendation the almost certain command which it has over this affection, it would be a highly valuable medicine. Ordinary hiccough is quite trivial; but sometimes, whether as an apparently original affection, or as an attendant on other diseases, it is extremely obstinate and troublesome, racking the patient, preventing sleep, and wearing out the strength by its constant agitation. I have known it to continue in this way for a week, resisting all ordinary measures, and reducing the patient almost to despair. So far as my observation has gone, and it has been somewhat extensive, musk has never failed to put an end to the affection, and in general very promptly. The only instance in which it did not effect an entire cure was an intermittent attack of the spasms, occurring in paroxysms at regular intervals. Musk always controlled the paroxysms, but they returned at the stated period, and were finally arrested by quinia. In another case, of an extremely obstinate character, I had used the remedy for twenty-four hours without effect; when, on examining the musk, I found it very feeble. Another parcel was sent for from a different quarter, and promptly arrested the affection. It was used in the ordinary dose.

Various Nervous Diseases. Musk has been commended in hysteria, chorea, epilepsy, tetanus, eclampsia, mania, and even hydrophobia, and has been employed also in asthma, hooping-cough, palpitations, cholera, and colic. It may no doubt be useful in most of these affections, under circumstances calling for the nervous stimulants; but it is probably in no case more efficacious than some other articles of the class, might under many circumstances prove injurious if not used with great discrimination, and has been abandoned generally by the profession after a fair trial. I need not say that it is altogether useless in hydrophobia. Its enormously high price when pure, and the great uncertainty as to the degree of its purity as it is kept in the shops, are also strong objections to its use, and have, no doubt, very much contributed to the neglect into which it has fallen. I would, however, urge its use upon the profession, in the affections in which it has been recommended above; namely, in *obstinate hiccough*, and the *convulsions of infants from intestinal spasm*, from my own experience; in *painful spasms of the involuntary muscles with collapse of the system*, especially when gouty, upon the authority of Cullen, and general experience; in the *peculiar condition of pneumonia* referred to, on the authority of M. Récamier and of MM. Trousseau and Pidoux; and in the *collapse of the first stage of pernicious fever*, upon the ground of reason and analogy.

Administration. Musk is given in substance; all officinal liquid preparations of it having been generally abandoned. The dose is from five to thirty grains; but the least quantity which should be given to an adult, as the drug is usually found in the shops, is ten grains; and this should always be increased, if found to produce no observable effect on the system. Should the dose occasion a feeling of weight, vertigo, or pain in the head, it ought to be somewhat diminished. It may be given in pill, or emulsion; in the latter form, being suspended in peppermint water or diluted cinnamon water, by means of gum arabic and sugar. Great care should be taken that no particle should be spilled when it is exhibited; as it will long scent the apartment disagreeably, and to some perhaps injuriously.

II. CASTOR.

CASTOREUM. *U. S.*, *Br.*

Origin. Castor is a product of the beaver, *Castor Fiber* of naturalists. In this animal, in both sexes, there are two pairs of follicles or small sacs, situated between the anus and external genitals, of which the lower and larger contains the castor. After death, this is removed and dried, the pair being still connected by a slender cord, which is their excretory duct.

Two varieties of castor are recognized in the books, one collected in Russia, the other in the northwestern parts of this Continent, distinguished as the Russian, and American or Canadian castor. The latter alone is used in this country.

Properties. The two sacs composing the pair are of unequal size, the larger being usually two inches or more in length. They are pear-shaped, but much flattened and wrinkled, brown or blackish externally, and internally divided by a whitish membrane into cells, which contain the castor. This is softish when fresh, but hardens with time, and then, though somewhat unctuous to the touch, is brittle, and exhibits when broken a resinous lustre. Its colour is brown or reddish-brown; its odour strong, fetid, and peculiar; and its taste, bitter, acrid, and disagreeable. It yields its virtues to alcohol or ether, but not to water. Upon distillation it yields a little volatile oil, having its characteristic odour and taste, and upon which possibly its virtues may depend; but this point has not been decided.

Castor deteriorates by time, but very slowly if kept in a cool, dry place. Exposed to heat and moisture, it speedily undergoes decomposition.

Effects on the System. From the small doses in which castor is usually given as a medicine, no observable effect is experienced unless occasionally unpleasant eructations. Mr. Alexander states, in his experimental essays, that he took two drachms of it, at various doses, without any other effect than this. Jörg and his pupils experienced only slight uneasiness of the stomach, with disagreeable eructations. Thouvenal, however, found it, in the quantity of about half an ounce, to increase the frequency of pulse and heat of skin, and to produce other excitant effects. If a stimulant, therefore, to the circulation, it is a very mild one; but it must not be inferred that it is inert as a medicine; for the influence of the class of medicines now under consideration upon the nervous system is, in no degree, measured by that which they may exercise upon the heart and arteries; nor is their remedial power in nervous diseases to be measured by their apparent effect in health; so that the efficiency of castor as a medicine must be decided solely upon the ground of experience. This would seem to have determined in its favour, if medical testimony is to be admitted as having any authority; yet the medicine is certainly not very powerful.

Therapeutic Application. Castor was used by the ancient Greeks, and has ever since held its place in the Materia Medica catalogues. It was anciently employed chiefly in hysteria and amenorrhœa. By modern physicians it has been given in most of the nervous diseases, already enumerated as affording indications for the nervous stimulants. At present it is probably most used to relieve the disordered nervous phenomena of low fevers, and in the different phases of hysteria, especially when associated with suppression or retention of the menses. Trousseau and Pidoux speak in decided terms of its utility in amenorrhœa, attended with painful tympanites, and in hysterical colic, with paleness, cold sweats, and sudden prostration. In the North of Europe it is said to be used for promoting labour, and the expulsion of the placenta. I can say nothing of it from experience, having very seldom used it.

The dose of ten or twenty grains, usually mentioned in the books, is probably too small, and may be at least doubled. It may be given in pill or emulsion.

Tincture of Castor (TINCTURA CASTOREI, *U. S.*, *Br.*) is prepared with undiluted officinal alcohol, and given in doses varying from thirty minims to two fluidrachms, which might be doubled, should the quantity of alcohol not be contraindicated.

An *Ammoniated Tincture* (TINCTURA CASTOREI AMMONIATA, *Ed.*) was directed by the Edinburgh College, but has been omitted by the British Pharmacopœia. It was made with assafetida, castor, and the spirit of ammonia of that College, itself a very active stimulant. It was no doubt an energetic antispasmodic and stimulant; but owed its powers much less to the castor than the other ingredients. It might be used in spasm of the stomach, and other nervous affections demanding active stimulation. The dose would be from thirty minims to two fluidrachms.

◆

III. ASSAFETIDA.

ASSAFŒTIDA. *U. S.*, *Br.*

Origin. Assafetida is a concrete juice, derived from the root of *Narthex Assafœtida*, an umbelliferous herb, from six to nine feet high, growing in the interior mountainous regions of Persia, and neighbouring countries.

It is obtained by twisting the leaves from the root, digging the earth from about it, then slicing off the top of it transversely, and scraping the juice from the surface as it exudes; the leaves being employed to shelter the wounded root from the sun. When the exudation ceases, another slice is removed; and so on, till the root is exhausted.

The juice thus collected is allowed to concrete in the sun, and is then taken to Bushire, whence it is carried in vessels to Bombay, and from that port is distributed over the world.

Properties. Assafetida is in irregular lumps or masses, often softish in the interior as first imported, but gradually becoming hard and brittle. The colour is brownish externally, but, upon the freshly broken surface, is whitish or variegated, quickly becoming red on exposure to the air, and ultimately changing to brown. The lumps are sometimes homogeneous or nearly so; but usually consist of smaller portions aggregated, or of whitish tears imbedded in a darker paste. The odour is strong and extremely fetid, so as to have acquired for the drug the name of *stercus diaboli.* Yet it sometimes becomes tolerable by habit; and it is not requisite to go so far as the East Indies to find individuals who are even fond of it. The taste is bitter and subacrid. In certain parts of Hindostan, the inhabitants use it habitually as a luxury; and the streets of Surat are said to be sometimes redolent of the drug. Both the smell and taste are diminished by drying, and by age; and, in the recent condition of the juice, the former is said to be intensely offensive. Assafetida softens by heat, but cannot be quite melted. It is very inflammable.

In chemical constitution it is a gum-resin, consisting of gum, resin, and volatile oil. The odour is owing to the oil, the medical virtues to that and the resin conjointly, and the gum is inert. When rubbed with water, the gum-resin forms a white milky emulsion; the resin and oil being suspended by the intervention of the gum. This emulsion often assumes a pinkish hue on exposure. Alcohol dissolves all the active matter, forming a transparent tincture, which becomes turbid on the addition of water, in consequence of the separation of the resin.

Effects on the System Assafetida stimulates the stomach and the circulatory system moderately, and the general nervous system powerfully, is somewhat expectorant and often laxative, and is believed by some to have emmenagogue and anthelmintic properties. In moderate medicinal doses, it produces a feeling of warmth in the stomach, somewhat increases the frequency of the pulse and the heat of skin, often more or less exhilarates the spirits, and is said also to excite the genital organs, and sometimes to bring on the menstrual flow in women. When rather freely taken, it occasionally produces slight vertigo or headache, but never intoxication or stupor. It not unfrequently operates as a cathartic, but not so uniformly as to deserve to rank in that class of medicines. In large doses it disturbs the stomach, and may even excite nausea and vomiting; but these are rare effects when that organ is quite sound. That it should cause offensive eructations is a necessary result of its fetid odour and carminative properties.

The volatile oil of assafetida is certainly absorbed. A sufficient proof of this is the fetid odour of all the secretions under its use, of the breath, the perspiration, the urine, and, as has been asserted, of the discharges from ulcerated surfaces. As the oil is probably the main active principle, the drug no doubt produces its constitutional impression through the circulation; though it is highly probable that the offensive odour may sometimes also act favourably on the cerebral centres, through the sense of smell.

Therapeutic Applications. Assafetida is a highly important medicine, and there is reason to apprehend that it may be too much neglected in consequence of its extreme offensiveness. The probability is that it was employed by the ancient Greek physicians; though some doubt has been entertained upon that point. It was certainly known to the Arabians, and appears to have been introduced by them into modern Europe, through the school of Salernum.

It may be employed in almost all cases of nervous disease calling for medicines of this class, and, upon the whole, may be regarded as the most useful of them. Less powerful than musk in overcoming obstinate hiccough, in relaxing those painful spasms of the involuntary muscles which have a deeper source than mere hysteria, and in rousing up the nervous centres from profound torpor or prostration, it is superior to it in hysteria, and in certain other nervous affections which will be noticed immediately, and probably quite equal in general efficiency.

In *hysteria*, in almost all its forms, assafetida is a most valuable remedy. Even the convulsions of this disease will often yield to it, or undergo favourable modification under its use. In such cases, as it is often impossible for the patient to swallow, it should be exhibited by enema. In the same form, also, it may be employed in *general hysterical insensibility* simulating coma, and in *dysphagia* arising from *hysterical spasm of the œsophagus.*

In the allied disease of *hypochondriasis* in males, it is among the remedies which afford most relief to the various nervous disorders, though it may be inadequate to the cure.

In all *convulsive affections*, purely functional, that is, unconnected with active congestion, inflammation, or other form of organic disease, it may be used with reasonable hope of benefit. The particular form, besides the hysterical, in which most good may be expected from it is that of *infantile convulsions*, arising from spasm in the intestinal tube. It should be given, in cases of this kind, by enema during the convulsion, and by the mouth, at regular periods, every hour, two, or three hours, in the interval. *Epilepsy* is quite beyond its unaided powers; though the medicine may sometimes relieve it, and, in connection with other medicines, may even contribute to its cure when purely functional. In *chorea* it is occasionally adequate to the cure, if employed in association with cathartics; the patient being kept steadily under the use of the assafetida, while a purgative is given every second or third day.

Hooping-cough is one of the complaints in which assafetida is most useful. After the subsidence of the initial catarrhal symptoms, and when those of a spasmodic character have become fully established, it should be given regularly, every two or three hours, until the violence of the paroxysms has begun to abate. The child receives so much relief from the medicine, that, after having become accustomed to its taste, he will often call for it, even by cries, if too young to speak. This I have seen repeatedly.

Nervous coughs sometimes occur, which, after obstinately resisting measures addressed to them as catarrhal, will yield at once to a few doses of assafetida. They are most frequent in women, though I have seen them when there was no reason to suppose them hysterical, and have found them to yield as promptly as if they had been merely a phase of that disease. In some of these cases, the cough may be a form of nervous gout or rheumatism. I would urge upon the inexperienced practitioner to be on the watch for these cases. When he encounters a severe and harassing cough, which can be traced to no special source, and which, he is satisfied, cannot depend on inflammation of any part of the air-passages, let him try assafetida, and I feel quite sure that he will often find it successful. The nervous element may even complicate ordinary coughs, and give them an unusual obstinacy, which will yield by combining the use of assafetida with the other measures indicated.

The medicine may be employed in the paroxysms of *spasmodic asthma*, but cannot be relied on in that affection. In complicated cases, however, in which the dyspnœa is associated with chronic catarrh, the system being feeble, and the circulation and skin relaxed, it may be of much service by its combined expectorant and antispasmodic powers.

Laryngismus stridulus, or pure spasm of the glottis occurring in infants, is said to have been beneficially treated with it, but I have not used it in that complaint.

I would particularly call attention to a certain condition in the *advanced stage of pectoral inflammation in infants and young children*, whether *bronchial* or *parenchymatous*, in which assafetida is an admirable remedy. In patients of this age, the nervous system is very apt to suffer, whatever may be the nature of the case, if in any degree severe. Even in their inflammations, the nervous centres seem to become exhausted before the disease has run its course, and alarming symptoms from this cause not unfrequently complicate the case. In the pectoral inflammations, this condition may be readily, and, I believe, often has been fatally overlooked. This is probably one of the reasons of the great mortality of infantile bronchitis and pneumonia. The nervous exhaustion shows itself by symptoms which may be readily mistaken for an aggravation of the original affection. The respiration is much hurried, the alæ nasi visibly expand and contract, the child is sometimes anxious and restless when not stupid, and the pulse is very frequent and feeble. Under such circumstances, if the patient is at a somewhat advanced period of the disease, and, upon application of the hand, it should be found that the ears, tip of the nose, cheek, or fingers feel cold, or even cool, it may be taken for granted that the system, and especially the nervous centres of respiration, need support; and this support assafetida, freely used, and repeated every hour or two, will often yield, to the vast relief of the patient. I am quite confident that I have seen lives saved, mainly by this remedy, in the condition referred to. While useful as an expectorant, it operates, I believe, chiefly by stimulating the exhausted nervous centres. My attention was first called to such cases by my preceptor, the late Dr. Jos. Parrish, and I have since had frequent occasion to thank him for the valuable practical lesson.

In *low states of fever*, assafetida is sometimes useful in obviating nervous symptoms, such as *subsultus*, *general tremors*, *restlessness*, *hiccough*, etc.; but it is not more efficacious than other much less disagreeable remedies, and is, therefore, little used. In the *tympanites*, however, of these complaints, given as an injection, it is a valuable remedy, second only to the oil of turpentine in efficiency.

In *constipation with flatulence* in old people or hysterical women, and in the *colicky affections* of the latter class, assafetida may often be advantageously combined with laxatives, such as aloes and rhubarb. If *amenorrhœa* be superadded, myrrh may be combined with the other ingredients; and, if *anæmia*, one of the preparations of iron.

The laxative properties of the gum-resin often add to its advantages as a nervous stimulant; but sometimes it is necessary to counteract them with a little laudanum.

Of the special uses of this gum-resin as a stimulating expectorant there will be occasion to treat hereafter.

Assafetida is *contraindicated* in acute inflammation, and in fever with hot skin, and a full, strong pulse; and especially so when the nervous centres themselves are the seat of high vascular irritation, inflammation, or organic disease, even though convulsions, spasm, or other nervous disorder should appear to indicate the use of this class of medicines.

Administration. The dose of assafetida is from five to twenty grains. More, however, might sometimes be given with safety and probable advantage. It should generally be administered in pill or emulsion; the former being preferable whenever the latter form is not specially called for, in consequence of the opportunity it affords of concealing the taste and smell. The emulsion, however, is always preferable when a prompt effect is desirable; and this is most frequently the case. It may be made by simply rubbing the gum-resin thoroughly with water, and straining.

The emulsion is directed, in the U. S. Pharmacopœia, under the name of *Assafetida Mixture* (MISTURA ASSAFŒTIDÆ). It is the *milk of assafetida* or *lac assafœtidæ* of the older pharmacy. A fluidounce contains fifteen grains, and one or two tablespoonfuls may be given for a dose.

As an *enema*, assafetida is administered in the form of emulsion; and from half a drachm to two drachms may be used in half a pint of water.

The *Tincture of Assafetida* (TINCTURA ASSAFŒTIDÆ, *U. S.*, *Br.*) may be given in cases where a prompt effect is required, and there is no objection to the alcohol. Officinal or undiluted alcohol is used in its preparation. The medium dose is a fluidrachm. It should be diluted with water, which becomes milky by the separation of the resin.

Pills of Aloes and Assafetida (PILULÆ ALOES ET ASSAFŒTIDÆ, *U. S.*, *Br.*) are officinal. They contain equal quantities of aloes and assafetida mixed with soap, and are given in torpid bowels with flatulence and debility of the alimentary canal. From two to five of the pills, each containing four grains, may be given for a dose.

A *Plaster of Assafetida* (EMPLASTRUM ASSAFŒTIDÆ, *U. S.*) is also officinal. It is used as an application to the chest, or between the shoulders, in hooping-cough, and over the abdomen in the flatulent colics of hysteria.

* * *

Several other gum-resins, having properties analogous to those of assafetida, though much inferior, have been more or less in use from the times of the ancient Greeks and Romans. At present, however, they are much less employed than formerly. A very brief notice of them will be sufficient; as there is not one of them which might not very well be dispensed with, in reference merely to its powers as a nervous stimulant. The medicines alluded to are sagapenum, galbanum, and ammoniac.

1. SAGAPENUM. *Lond.*

Though recognized in the late London Pharmacopœia, this is no longer officinal, having been discarded in the British. It is the concrete juice of an unknown Persian plant, supposed to be umbelliferous; and is imported from the Levant. As brought to us, it is either in irregular masses of agglutinated tears, translucent, and of a wax-like consistence, or in soft adhesive masses, in which no tears are visible. It has a brownish-yellow, reddish-yellow, or olive colour, paler within than without, and becoming darker by time. The odour is alliaceous, but weaker and less disagreeable than that of assafetida; the taste, bitterish, somewhat acrid, and nauseous. It becomes softer and tenacious by heat, and is inflammable. Water and alcohol dissolve it partially, diluted alcohol completely. It consists essentially of volatile oil, resin, and gum, of which the two former are probably the active constituents. The odour depends upon the oil.

This gum-resin produces effects on the system similar to those of assafetida, but is too feeble to be depended on as a substitute, in which capacity it might otherwise be used, in consequence of its less offensive odour. It is occasionally employed as an adjuvant to cathartics, in flatulent states of the stomach and bowels. The dose is from ten to thirty grains, which may be given in pill or emulsion.

2. GALBANUM. *U. S.*, *Br.*

Galbanum is the concrete juice of an uncertain plant, probably a species of Ferula, growing in Persia, on the borders of the Caspian. It is said sometimes to be procured by incision, sometimes to exude spontaneously, and harden in the form of tears. In this latter state it is occasionally, though rarely, imported; the tears being about as large as a pea, round, shining, translucent, and of a yellowish or brownish-yellow colour. More frequently it is in masses composed of whitish, reddish, or yellowish tears, simply agglutinated together, or imbedded in a darker, yellowish-brown, or greenish substance. It has the consistence of wax, but softens with heat, and at the temperature of the surface becomes adhesive. At 212° Fahr. it melts so that it can be strained, and is thus freed from impurities. Its odour is peculiar and disagreeable; its taste, bitterish, warm, and acrid. Water dissolves it partially; alcohol, its oil and resin; diluted alcohol, the whole of it, excepting impurities. It consists of gum, resin, and volatile oil, of which the two latter are active.

Its medical properties are similar to those of sagapenum, though generally considered feebler. With a slightly stimulant influence over the circulation and nervous system, it has been supposed to unite expectorant and emmenagogue powers; and hence has been given in hysteria and other nervous disorders, enfeebled digestion, flatulence, chronic bronchial affections, chlorosis, amenorrhœa, chronic rheumatism, etc. It was formerly very much employed, and entered into a large number of preparations for internal and external use. But it has been almost wholly superseded by assafetida, and is little used at present. The *dose* is from ten to twenty grains, given in pill or emulsion.

Compound Galbanum Pills (PILULÆ GALBANI COMPOSITÆ, *U. S.*; PILULA ASSAFŒTIDÆ COMPOSITA, *Br.*), composed of galbanum, myrrh, and assafetida, are officinal. They are used as a nervous stimulant and emmenagogue, in hysteria and amenorrhœa, in the dose of from ten to twenty grains.

Dr. Arnold has strongly recommended the local use of a *tincture of galbanum* in various diseases of the eye, such as scrofulous ophthalmia, ocular debility from prolonged reading, spasmodic motions of the eyelids, œdema of the eyelids, weakness of the lachrymal canal, etc. He moistens the surface of a compress with the tincture, and applies it immediately over the eye for an hour; then removes it for several hours, and again applies it; and thus successively till the object is accomplished. A burning heat is first felt, which gradually lessens, and ceases within an hour, when the compress becomes dry. The tincture may be made by dissolving an ounce in a pint of diluted alcohol. (Mérat et De Lens, *Dict. de Mat. Méd.*, i. 685.)

The *Compound Galbanum Plaster* (EMPLASTRUM GALBANI COMPOSITUM, *U. S.*), which consists of galbanum, Burgundy pitch, turpentine, and lead plaster, is a good discutient application in chronic scrofulous swellings, inflammatory indurations, and chronic rheumatic and gouty disease of the joints; care being taken that signs of acute inflammation should always be absent.

3. AMMONIAC.—Ammoniacum. *U. S., Br.*

This gum-resin will be hereafter treated of as a stimulant expectorant, when its origin, properties, composition, and physiological effects will be detailed. In the present place it is sufficient to state that, along with other properties, it is supposed to possess those of a nervous stimulant, in a degree somewhat less than the two preceding gum-resins. In this capacity, it has been considered useful in obstinate colicky affections of the bowels with constipation, and in asthma complicated with chronic bronchitis, being aided in the former of these affections by its laxative, and in the latter by its expectorant properties. The dose of it is from ten to thirty grains, given in the form of pill or emulsion.

Ammoniac is used externally, as a local stimulant, in the form of *Plaster* (Emplastrum Ammoniaci, *U. S.*). This often produces a papulous eruption, and sometimes considerable inflammation of the skin. It is used chiefly to promote resolution of scrofulous tumours, and other chronic swellings of the joints. Combined with mercury, as it is in the *Plaster of Ammoniac with Mercury* (Emplastrum Ammoniaci cum Hydrargyro, *U. S., Br.*), it acquires increased discutient powers; and in this form is applied additionally to venereal nodes and tumefactions, and over the region of the liver in chronic hepatitis. This plaster sometimes affects the gums.

IV. VALERIAN.

VALERIANA. *U. S., Br.*

Origin. This is the root of *Valeriana officinalis*, a European herbaceous perennial from two to four feet high, with branches terminating in clusters of small sweet-scented flowers. The plant is now cultivated in this country for medical use. The root is collected preferably in the autumn after the decay of the leaves, or early in the spring before they appear.

Properties. The root consists of a small tuberculated head, sending forth numerous long cylindrical fibres or radicles, and bears no inconsiderable resemblance to Virginia snakeroot. The colour of the radicles is externally yellowish or brownish, internally white; that of the powder yellowish-gray. The odour, which in the fresh root is slight, is, in the dried, strong, somewhat aromatic, and highly peculiar. To some it is agreeable, to others the reverse. Cats are said to be extremely fond of it, and under its influence to experience a kind of intoxication. The taste is at first sweetish, afterwards bitterish, somewhat acrid, and disagreeable.

Active Principles. The active principles are a peculiar *volatile oil*, and probably an extractive matter of a sweetish and slightly bitter taste called *valerianin*. Upon the former depend the stimulant properties of the root; the latter may be slightly tonic. The oil of valerian, being one of the officinal preparations of the root, will be noticed more particularly below.

Effects on the System. Different opinions are held as to the stimulant influence of valerian on the circulation: some believing it to have such an influence, others denying it altogether. I am among those who consider it as in general very moderately stimulant, though its effects in this respect are somewhat uncertain. Upon the stomach it also produces a slightly excitant impression, which, when it is largely taken, often amounts to irritation. Upon the nervous system, however, its action is more decided. This is shown, in the ordinary medicinal doses, rather by its influence in composing nervous disorder, than by any decided disturbance of the nervous functions in health, unless, perhaps, in certain very susceptible persons. But in very large doses, it produces, even in robust individuals, some degree of headache, vertigo, and disturbance of sight and hearing; and in others of a more nervous temperament, may superadd to these effects more or less mental excitement, visual illusion, general agitation, and even involuntary muscular movement. It never, however, causes positive delirium or coma; and is probably incapable, in any quantity, of acting as a poison. It sometimes disturbs the bowels.

Therapeutic Application. We have no proof that valerian was employed by the ancients. Much more efficacy has been ascribed to it by many writers than it is now generally believed to possess. I have never, myself, seen from it anything more than very moderate remedial influences. It was brought into notice by *Fabius Columna*, a Neapolitan of high birth, who, labouring himself under epilepsy, and searching eagerly in the field of botany for a remedy, thought he had found it in valerian. Many reports have since then been made of its efficiency in that disease; but the credit of curing epilepsy is one which it must share with numerous other substances, not a few of which are much more inert than itself. In this disease, the mental condition of the patient has great influence; and anything which strongly excites his confidence or his hopes, may, for a time, and occasionally does, for a considerable time, suspend the recurrence of the paroxysms. If, in the mean time, the cause which sustained the disease should have ceased, a permanent cure might seem to have been effected by what is in itself wholly useless. Nevertheless, it would not be proper to deny all efficiency to valerian in epilepsy. In some purely functional cases, before the disease had become firmly seated in the habits, if not in the structure of the brain, it may possibly have set it aside; and it may be exhibited, with some hope of benefit, as an adjuvant of more powerful remedies; but no curative effect can be expected from it, unless freely given and long persevered with; and reliance should never be placed upon its exclusive use. To the cure of fixed epilepsy it is quite inadequate.

The morbid conditions to which valerian is most appropriate are the *milder forms of hysteria* and *hypochondriasis*, in which the indication is to obviate depression of spirits, or to control the slighter nervous irregularities, which, in countless diversity, are springing up in the course of the former disease. Even under such circumstances, it is probably more used as an adjuvant to other remedies intended to make a permanent and curative impression than exclusively for its own effects. Thus, in a case of chlorosis, while the disease is pursuing a regular march towards health, under the use of the chalybeates and a good diet, valerian may sometimes be employed advantageously to quiet palpitations, relieve unpleasant cerebral sensations, or general uneasiness, and obviate irregular muscular movements of various kinds.

Not unfrequently, *dyspepsia* is accompanied with much nervous discomposure, especially in women, and in those, too, who have shown no tendency to hysteria. Valerian may often be usefully associated, in such cases, with the bitter tonics, laxatives, etc., which may be employed to meet more important indications. The same may be said of its use in other diseases of depression or debility, in which nervous disorder is a mere attendant phenomenon, having no important signification, but nevertheless often very annoying to the patient. Its application to the relief of wakefulness, restlessness, general uneasiness, muscular tremors, etc., complicating *low febrile diseases*, would come into this category; though the same ends may generally be better attained by the use of Hoffmann's anodyne, sweet spirit of nitre, camphor water, etc., than by valerian. Dr. D. Leasure, of New Castle, Pennsylvania, speaks very favourably of oil of valerian, in typhoid fever, alternated with oil of turpentine. (*Transact. of the Med. Soc. of the State of Pa.*, 1856, p. 102.)

In the treatment of *hemicrania*, it has enjoyed some reputation in connection with Peruvian bark or sulphate of quinia. I have repeatedly, in former times, seen this very troublesome affection yield, in two or three days, to an ounce or two of bark taken daily, in divided doses, in a pint or two of infusion of valerian. The first effect was generally somewhat to augment the pain; but it ceased at the end of the time specified. On making similar attempts more recently, with sulphate of quinia and oil of valerian, I have not been in an equal degree successful. It is not impossible that the oppression of stomach, produced by the bark in powder, may have had something to do with the result.

M. Rayer has found valerian efficacious in a case of *excessive thirst* in a boy, attended with a copious discharge of light-coloured, limpid, inodorous, and tastless urine. The quantity of liquid drank and discharged was enormous. The affection was looked on as nervous, and yielded in about a month to the powder of valerian, employed under this view of its nature.

Administration. Valerian is most effectively given in the form of powder, which should be preferred when a strong impression is desired. The dose is from thirty to ninety grains three or four times a day, and may be increased, if thought desirable, so that an ounce may be taken in twenty-four hours; the quantity being of course diminished if unpleasant cerebral phenomena should occur.

The *Infusion* (INFUSUM VALERIANÆ, *U. S.*, *Br.*) is officinal, and is directed to be made in the proportion of half an ounce to a pint of boiling water. The medicine is said to be less apt to irritate the bowels in this form, than in that of powder. The dose is two fluidounces.

There is also an officinal *Tincture* (TINCTURA VALERIANÆ, *U. S.*, *Br.*), which has the virtues of the medicine, but unfortunately also the stimulant properties of alcohol, which, except under rare circumstances, should forbid its use. The danger of its abuse, when carelessly prescribed for slight nervous affections, is too obvious to require that more should be said to put the young practitioner on his guard. The dose of it is one or two fluidrachms.

The *Ammoniated Tincture* (TINCTURA VALERIANÆ AMMONIATA, *U. S.*, *Br.*) is a much more effective preparation, being made with aromatic spirit of ammonia instead of diluted alcohol. The dose is from thirty minims to a fluidrachm, which should be largely diluted. It is especially indicated in cases of hysteric spasm of the stomach, or troublesome flatulence having the same origin.

An *Alcoholic Extract* (EXTRACTUM VALERIANÆ ALCOHOLICUM, *U. S.*) is directed in the U. S. Pharmacopœia, but, though prepared with every precaution to avoid the volatilization of the active principles of the root, is scarcely, I think, an eligible preparation; yet it has the advantage that it may be given in the pilular form. The dose is from ten to thirty grains.

The *Fluid Extract of Valerian* (EXTRACTUM VALERIANÆ FLUIDUM, *U. S.*), which is peculiar to the U. S. Pharmacopœia, is an elegant preparation, concentrating the virtues of the medicine in a small bulk convenient for administration. The dose is about a fluidrachm.

The *Volatile Oil* (OLEUM VALERIANÆ, *U. S.*), which is supposed to have all the virtues of valerian as a nervous stimulant, is now much used as a substitute. It is obtained from the root by distillation with water. As first procured, it is of a pale-green colour, with a pungent odour of valerian, and a somewhat aromatic taste. By exposure, however, it becomes yellow and thick, in consequence of the absorption of oxygen. Much importance has recently been attached to the fact, that this oil contains, associated with it, a peculiar volatile acid, denominated *valeric*, or *valerianic acid*, which may be separated by a chemical process. This acid is a colourless volatile liquid, having a very offensive odour, recalling that of valerian, yet quite different, and a sour disagreeable taste. It forms salts with the acids, and carries its odour in some degree with it in the combination. It has been supposed to be one of the active principles of valerian, if not the most active; but, when it is considered that, if it exist at all in valerian uncombined, it cannot be in any considerable proportion, this idea must be abandoned. It is the result of the oxidation of one of the two oils which conjointly constitute the oil of valerian, and may be much increased by the reagency of an alkali, which disposes to its formation, and then combines with it. The dose of the oil is from four to six drops.

Various salts of *valerianic acid* have been introduced into medicine, under the notion that this acid was the active principle of valerian, and would carry its peculiar virtues with it into the combinations it might form with salifiable bases. Hence the *valerianates* of *iron*, of *zinc*, and of *quinia*, which have been added to the list of medicinal preparations. Experience has not shown that they possess any peculiar advantages over the other salts of those bases respectively, while their repulsive odour and comparative cost are real objections. Valerianate of ammonia, however, has acquired a reputation which demands for it a particular consideration.

VALERIANATE OF AMMONIA.—AMMONIÆ VALERIANAS. *U. S.*

This salt is prepared by saturating valerianic acid with ammonia. The chief difficulty is in obtaining it dry and crystallized, in consequence of its extreme deliquescence.

It is in white pearly quadrangular plates, of a strong very disagreeable smell like that of valerianic acid, and of a peculiar sweetish taste, with little pungency. It is very deliquescent in a moist air, soluble in all proportions in water and alcohol, and volatilizable by heat with partial decomposition. When kept in a bottle, which is occasionally opened, the crystals acquire a yellowish colour.

Its effects on the healthy system in remedial doses are not striking; and the only inconvenience experienced, when it has been taken too freely, is some disturbance of the head. From trials made by MM. Laboureur and Fontaine, it seems to exercise no injurious influence on the animal economy; two or three drachms of it having been given to dogs without serious effect. It appears that the idea of employing it therapeutically originated with M. Pierlot, an apothecary of Paris; but the attention of the profession was first decidedly directed towards it by Dr. Declat, who, in December, 1855, used it in an obstinate *facial neuralgia*, which had lasted very long, and resisted all remedies, but yielded immediately to this. It was afterwards employed in similar cases with remarkable success, and is now among the most esteemed remedies in *neuralgic affections*. It has since been given in other nervous affections, as epilepsy, hysteria, chorea, etc. The dose of it is from one to six or eight grains, which may be dissolved in from one to four fluidrachms of pure or aromatic water, and sweetened if desired. A single dose is said often to relieve the pain; but it may be repeated, if needful, several times a day.

In relation to the valerianates used in medicine, M. Landerer has found that the valerianic acid artificially prepared, is decidedly inferior to that obtained from the root, which, therefore, should always be preferred in medicine. (*Journ. de Pharm. et de Chim.*, 3e sér., xlii. 77.)

V. GARLIC.

ALLIUM. *U. S.*

Origin. Garlic consists of the bulbs of *Allium sativum*, or common garden garlic, a native of Europe, but cultivated in most civilized countries. The bulbs, when taken from the ground, are dried, usually with portions of the stems remaining, by which they are tied into bundles, and thus brought into market.

Properties. The bulb of garlic consists of five or six smaller bulbs, commonly called *cloves*, each invested with a distinct coat, and the whole compactly arranged around the stem at its base, and inclosed in a white membranous covering, consisting of several thin, delicate layers. The substance of the minor bulbs, deprived of their coat, is whitish, moist, and fleshy, and contains a juice, which, on the addition of a little water, may be separated by expression. When these little bulbs become dry, as they do when very long kept, the medicine is wholly useless.

The odour of garlic is strong, penetrating, disagreeable, and characteristic; so much so that it serves as a standard of comparison for other odours, which, when thought to resemble it, are said to be alliaceous. The taste is bitter and acrid. These properties, as well as the medical virtues of garlic, are yielded to water, vinegar, or alcohol; but are impaired or destroyed by boiling. They depend on a peculiar *volatile oil*, which pervades the whole plant; but is especially abundant in the bulb. This is easily separated by distillation with water, leaving the residue quite inert. The oil, when pure, is a combination of carbon, hydrogen, and sulphur, constituting, according to Wertheim, the sulphuret of a compound radical denominated *allyl*, which consists of carbon and hydrogen (C_6H_5). After exposure to the air it contains oxygen.

Effects on the System. Garlic is a local and general stimulant, operating directly upon the part to which it may be applied, and, through the absorption of its active principle, upon the circulatory and nervous systems, and the various secretions. Its influence upon the nervous centres, though very decided, and quite sufficient to allow it to rank in the present class of medicines, has not, I think, been so prominently noticed by pharmacological writers as it deserves to be. It agrees, too, with the nervous stimulants in having no tendency to disturb the special cerebral functions.

Moderate doses warm the stomach, excite the appetite, and facilitate digestion. In a short time the frequency of the pulse and general warmth are somewhat increased; and the patient feels an agreeable excitement, which, though little noticed, contributes, I have no doubt, to the favour in which it is held as a condiment, notwithstanding its originally very repulsive odour and taste, by vast numbers of people, indeed by whole nations in some parts of the world. Through its influence on the secretions, it acts as an expectorant, sometimes as a diuretic or diaphoretic, according as it is directed by circumstances preferably to the kidneys or the skin, and also as an emmenagogue. It is said occasionally to prove anthelmintic. Too largely taken, it causes uneasiness of stomach, sometimes even nausea and vomiting, occasionally purges, and is capable of producing a febrile state of system, with headache, quickened pulse, heat of skin, etc. Applied to the skin it acts as a rubefacient, and will sometimes vesicate.

All these effects it owes to the volatile oil, which is absorbed with great facility, and rapidly pervades the whole system. Its absorption is proved by the odour it imparts to the breath, perspiration, urine, and even the secretions from the surface of ulcers. In the lower animals, it affects the milk and the flesh with its peculiar properties of smell and taste. The absorption takes place not only from the stomach, but readily also from the rectum, and even from the skin. Garlic poultices applied to the soles of the feet will sometimes communicate their odour to the breath. The oil, therefore, though quickly entering the circulation, has a tendency to leave it rapidly, and, as it passes out through the different emunctories, stimulates them into an increase of their several functions.

In its whole medicinal character, garlic bears a considerable resemblance to assafetida, though perhaps somewhat more stimulant locally and to the circulation, and somewhat less so to the nervous system.

Therapeutic Application. Garlic has been used as a condiment and medicine from times immemorial. Some of its most beneficial applications are grounded upon its properties as a nervous stimulant; and these are to be particularly noticed here. Its uses as a stimulating expectorant and diuretic will be referred to, under the heads of those classes respectively.

As a stimulant to the stomach it is useful in debility of that organ, enabling food of difficult solubility to be digested more readily, and more comfortably to the patient. It is also an excellent carminative, producing the expulsion of flatus, and relieving spasmodic pains which its presence is apt to occasion, whether in the stomach or bowels. But as the expelled air is impregnated with the oil, the eructations are apt to be offensive, if not to the patient, at least to others in his vicinity.

One of the most useful effects of the medicine is to relieve the various disturbances of the nervous system which are so apt to attend the febrile diseases of children, such as *restlessness*, *wakefulness*, *vague general uneasiness*, *twitchings of the muscles*, *startings*, and *convulsions*. For this purpose it is almost always used externally, being applied in the form of poultices to the feet, and as a lotion to the spine, made either by infusing the bruised bulbs for a short time in hot brandy, or by incorporating the expressed juice with oil or lard. The reader will observe that it is used here not merely as a revulsive agent, in which capacity it is inferior to mustard and other rubefacients, but in reference to the absorption of the oil, and its operation upon the nervous centres. It often most happily quiets the disturbance, and promotes sleep by correcting the state of the nervous system which prevented it.

In the *advanced stage of the inflammatory diseases of children*, and especially the pectoral, there is often a prostrated condition of the nervous centres, which very injuriously complicates the case. I have already, under the head of assafetida, called attention to this condition, and pointed out how it may be recognized, especially as attendant upon advanced bronchial and pulmonary inflammations. Garlic is scarcely inferior as a remedy to assafetida in some of these cases. I have used it often, and am quite sure with much benefit. It is not merely as an expectorant that it operates. It stimulates the nervous centres, and enables them to supply the necessary support to the functions of respiration and circulation, which are failing for the want of it. The remedy is especially useful, when, with this debility of function, there is also spasmodic complication, as in the affections referred to occurring in the advanced stages of hooping-cough, or in asthmatic children. I have usually employed it, in these cases, internally, in the form of syrup.

In almost all the *spasmodic and convulsive complaints of children*, whether affecting the alimentary canal, the chest, or the external muscles, or occurring as original affections, or as attendants on other diseases, garlic may be used externally, in the form of lotion or poultice; the application being made along the spine in convulsions, and both there and over the organ affected in internal spasms. The only contra-indication would be high vascular congestion or inflammation in the nervous centres.

In mild cases of *hysteria*, especially when affecting the stomach and bowels, as in spasmodic pains, flatulent discharges, borborygmi, etc., garlic is often useful, though not unfrequently objectionable in consequence of the odour imparted to the breath. In all hysterical affections, it may be freely employed externally.

The medicine was formerly used in *intermittent fever;* but has been abandoned since the discovery of Peruvian bark.

As a topical application to the ear, it has been used advantageously in *atonic deafness.* For this purpose, a small piece of raw cotton may be impregnated with the juice, and introduced into the external meatus. If it irritate too much, the juice should be diluted.

Applied in the shape of a large cataplasm to the hypogastrium, it has been recommended in *retention of urine* from debility of the muscular coat of the bladder, and incontinence from weakness of the sphincter.

As an *anthelmintic* it has enjoyed some credit, being used by the mouth, and, in the instance of ascarides, by the rectum.

As a resolvent in *indolent tumours,* and a stimulant in *chronic palsy* and *rheumatism,* it has been employed locally in the form of lotion or poultice.

Administration. The dose of garlic, in substance, is from half a drachm to one or two drachms for an adult. It may be given in the shape of pills, or bruised and mixed with syrup or other vehicle as an electuary, or in the state of the unprepared clove or small bulb, either whole, or cut into pieces of convenient size for swallowing. But neither of these forms is adapted to children.

The most convenient preparation for internal use in the case of children is the *syrup.* This may be made extemporaneously by bruising the cloves, adding a little water, so as to enable the juice to flow out, then expressing, and mixing the liquid obtained with twice its weight of sugar. There is an officinal *Syrup* (SYRUPUS ALLII, *U. S.*), which is prepared by first forming an infusion with vinegar, and afterwards incorporating this with sugar. The dose of either preparation for a child a year or two old is a fluidrachm, which may be repeated every hour or two, in acute cases.

For external use, *cataplasms* are made by thoroughly bruising the garlic, and incorporating it with the bread and milk poultice, or mixing it up with flaxseed meal or other adhesive powder, and hot water.

Lotions may be made by bruising the garlic, and heating it with proof spirit, which may then be applied by means of flannels wet with it, or by gentle friction.

A *liniment* may be prepared by incorporating the expressed juice with olive oil or lard.

A boiling heat should not be employed in the preparation of garlic, as it has the effect of driving off the oil.

Other species of Allium have effects analogous to those of *A. sativum.* The native garlic of our fields might probably be substituted without disadvantage. The onion (*A. Cepa*) and the leek (*A. Porrum*) have similar properties, but are much weaker. Nevertheless, a syrup made with expressed onion juice and sugar will be found useful in some of the pectoral affections, in which garlic has been recommended.

VI. COFFEE AND TEA.

I consider these two substances together, because their effects are of a closely similar character, and, where any difference exists, it can be readily indicated without producing confusion.

Coffee was introduced, under the officinal title of CAFFEA, into the U. S. Pharmacopœia, at the late revision of that work, and fully merits the recognition.

Of the origin and physical properties of coffee and tea it is necessary to say little, as they are generally well known. It will be sufficient to state, in relation to coffee, that it is the seed of the *Caffea Arabica*, a small tree, indigenous in Arabia and Africa, and largely cultivated in various tropical countries of the old and new continents; and, in relation to tea, that it is the prepared leaves of at least two shrubs, distinct species of *Thea*, *T. viridis*, and *T. Bohea*, both natives of China, the former of which probably produces *green*, and the latter *black* tea.

As regards the composition of these two products, there is one principle which they both possess, and upon which it is highly probable that the effects they produce in common upon the system, in some measure at least, depend. This has been called *caffein* as found in coffee, and *thein* as in tea; but the name generally recognized at present is the former, from whatever source the principle may be derived. So far as we are at present concerned with *caffein*, it is sufficient to state that it is a highly nitrogenized body, with feeble basic properties, crystallizable, of a slightly bitter and disagreeable taste, and soluble in water, alcohol, and ether. A remarkable fact in connection with this principle is, that it has been found in three vegetable products, namely, *coffee*, *tea*, and *Paraguay tea*, all quite distinct in their botanical affinities, inhabiting widely distant regions of country, and yet each one of them employed by the natives of the several regions they inhabit, and for the same purposes, without any previous intercourse. Providence seems to have distributed them over the world for the enjoyment at least, if not for the profit of the human family; and a sort of instinct to have led to their discovery and use. Caffein is thought to exist in coffee partly free, and partly combined with a peculiar acid.

Besides this principle, which is common to coffee and tea, there is in the former, according to Pfaff, a variety of tannin which he calls *caffeo-tannic acid;* and, after it has been roasted for use, two new substances appear to have been generated, one a *bitter principle*, and the other *an empyreumatic oil* to which it owes its peculiar flavour in this state. It is probably to the combined influence of the *caffein*, the *tannin*, and the *two newly developed empyreumatic products*, that we must ascribe the effects of coffee on the system.

Tea probably owes its active properties chiefly to the caffein, which is in somewhat smaller proportion than in coffee, jointly with a considerable quantity of *tannic acid* of the variety found in galls, a peculiar *bitter principle*, and a *volatile oil* to which may be ascribed its characteristic aroma. Though the two varieties of tea, the green and black, differ considerably in their taste, they agree very closely in chemical composition, and in their effects on the system; the latter being somewhat weaker than the former.

For a more particular account of the origin, preparation, and sensible and chemical properties of coffee and tea, the reader is referred to the U. S. Dispensatory. I have here called attention only to those points which have some immediate bearing upon their physiological and therapeutic effects.

Effects on the System. I shall first treat of the effects of roasted coffee, and afterwards allude to the slight differences which exist between them and the effects of tea. Unroasted coffee, being almost never used, will not be considered.

In moderate quantities, coffee stimulates the stomach gently, and the nervous system decidedly, without much exciting the circulation, or producing any narcotic impression on the brain. These are the properties which characterize the nervous stimulants, and to this class, therefore, it properly belongs. It will be found to belong to the same class equally by its therapeutic effects. Upon those who use it habitually, its characteristic influence is not fully evinced; as it has either lost its power in great measure by repetition, or the secondary are so mingled with the primary effects, that the latter are not readily distinguishable. The following are the phenomena of its operation in a system not yet rendered insensible to it by habit.

The first effect of a moderate quantity is usually a warming cordial impression on the stomach, which is followed after a short time by an agreeable feeling of comfort or satisfaction, and an obvious exaltation of the imagination and intellectual faculties. The disposition to cheerful conversation, or to other exercise of the mental powers, is awakened along with this increase in their vigour. Every one accustomed to witness social coffee or tea-drinking, must have noticed the increased vivacity, the more rapid interchange of thought, the general buzz which spreads through the company after partaking of the beverage. The student finds himself capacitated for a clearer understanding, and more prompt appropriation of the subjects of his study; the writer, for a more vigorous exercise of his mental powers, a quicker and happier arrangement of his thoughts or fancies, and a much greater facility of expression. In my own person, I every day experience something of this effect from black tea. For hours after dinner, even a moderate and entirely temperate dinner, I am often unable to perform, at all to my own satisfaction, any intellectual task which may have devolved upon me. An immediate change is produced by the tea, and, after the closing meal of the day, I find myself possessed of my intellectual capabilities, whatever they may be, to their full extent. Along with this nervous excitement, there is a strong tendency to wakefulness produced; and, under the influence of the beverage, if taken rather late in the evening, one's labours may often be prolonged far into the night, without any sense of fatigue or disposition to sleep. One or two cups of strong coffee at bedtime not unfrequently prevent sleep for the whole night; and persons who wish to watch prepare themselves often in this way. During all this time there is little acceleration of the pulse; and that which may be noticed is probably rather owing to the reaction of the excited nervous centres upon the heart, than the result of a direct influence upon the circulation. The state of exaltation subsides after many hours into a corresponding depression; and the self-indulgence is paid for the next day by feelings of gastric uneasiness, languor, and general malaise, which gradually wear off, or disappear under a repetition of the stimulant. It will be readily understood, therefore, that the habit of coffee-drinking is not on the whole healthful, unless carefully guarded as to extent, or counteracted by active physical exercise. I shall refer, directly, to the evils which are apt to result from the abuse of this luxury.

When coffee is taken in excess, it causes a feeling of oppression or anxiety in the epigastrium, with over-excitement of the nervous system, indicated frequently by vertigo, headache, palpitation, muscular tremors, and other symptoms of irritation of the nervous centres. But, even in the largest quantities, it never produces, so far as I have ever witnessed, intoxication or stupor, or any other of those peculiar effects on the brain, which characterize the cerebral stimulants or stimulating narcotics in full action.

The habitual use of coffee in excess is very apt to occasion a train of very disagreeable and annoying symptoms, which can only be got rid of by abandoning the habit. The constantly repeated over-excitement, followed by the as constant depression of the nervous functions, give rise at length to persistent irregularity; and the exhaustion of the excitability of the nervous centres by the strain to which they are subjected, ends in a deficiency of power, and a consequent insubordination of all the functions placed under their regulating influence. These effects are especially displayed in persons of susceptible nervous temperament, and those of sedentary habits. Some individuals appear to be almost insusceptible to influence of any kind from the ordinary use of coffee; and its effects, whether direct or indirect, may be greatly controlled by habits of steady and vigorous muscular exercise. Indigestion, habitual constipation, and torpor of the liver, are among the effects of its abuse exhibited in the digestive function; nervous headache, sick-headache, vertigo, various disorders of sight and hearing, neuralgic pains and an infinite diversity of disordered sensation, palpitations, muscular tremors, hysterical symptoms in women, hypochondriacal in men, are some of the consequences of the same abuse in the nervous system. As the blood-vessels are little excited directly by the stimulant, the vascular system is apt to suffer less than the nervous; and it is unusual to encounter, from the abuse of coffee, any of those inflammations, as of the stomach, liver, brain, etc., which are so apt to follow the use of the cerebral, or even the arterial stimulants in excess. Hence it happens that, unless the nervous disorder has been so long continued as to have at last brought about organic change, all that is necessary, in order to escape from the evils, is to abandon the use of coffee.

As illustrative of the above statements I will observe that, personally, being of a somewhat nervous temperament, I am unable to use coffee steadily without much suffering; and the same peculiarity belongs to most of my immediate family. For years I was troubled with frequently recurring nervous headache, which at times incapacitated me for the performance of any active duty. Scarcely a day passed without some uneasiness or deranged sensations in the head; such as roaring, buzzing, and singing in the ears, sounds as of pounding, or bell-ringing in the distance, swimming or vertiginous feelings, muscæ volitantes, etc., etc.; and I never walked in the streets without the fear of a sudden attack of these symptoms, which, when they came, took away all mental energy. It occurred to me that a single cup of coffee, which I was in the habit of taking daily in the morning, and to which I had reduced myself from the necessity of escaping the dyspeptic sufferings which a more free use of it had occasioned, might be the cause of these distressing phenomena. I abandoned the habitual use of it, substituting black tea for coffee; and from two weeks after that time up to the present, a period of many years, I have been almost entirely free from the symptoms referred to.

I was once called to a female patient labouring under great gastric uneasiness, troublesome palpitations, distressing nervous disorder of various kinds, and extreme emaciation. I requested to see her tongue. It was covered with small black points, which she told me proceeded from some burnt coffee she had been chewing. I wished to know if she was in the habit of using coffee freely. "Yes, doctor," she replied, "I drink it at breakfast, dinner, and supper, and chew the grains between whiles." I requested her to leave off the use of it entirely. She did so, and quickly recovered her health. I have no doubt that a vast deal of disease in our country, especially among the women, who in general drink coffee habitually, and use too little exercise, originates in this cause; and I have often been able to afford relief, in long standing cases of distress, by the simple measure recommended in the above case. I have dilated more largely on this point than may be deemed exactly in accordance with the general scope of this work; but I am desirous of impressing my views upon the profession, feeling confident that, if adopted, they will lead to beneficial results.

Method of Operating. The immediate effects of coffee on the stomach result, I presume, from its direct contact with the tissue. Those upon the nervous system are probably produced by some one or more of its ingredients being absorbed, unaltered or modified, into the circulation. I do not know that any positive proof has been adduced upon this point. Certainly caffein does not escape with the urine; and the odour of coffee is not sensible in the breath or perspiration. A few years since some interesting experiments were made, which were supposed to prove that coffee and tea diminish the rapidity of the physiological change of structure in nutrition. It has been found that certain miners, and other labourers, are enabled, by the use of coffee, to do as much work, without loss of flesh or strength, upon a much smaller amount of food, as when they drink water alone; and the experiments of Drs. F. W. Böcker and Julius Lehmann seemed to show, that the quantity of urea and other results of the metamorphosis of the tissues, lost through the emunctories, is much diminished by the use of these beverages. (See *Brit. and For. Med.-chirurg. Rev.*, Oct. 1854, Am. ed., p. 313.)* These are important results; but

---

* These results have been confirmed by the experiments of Dr. Wm. A. Hammond, of the U. S. Army, who, however, found all the constituents of the urine, and the quantity of the urine itself, to be diminished under the use of coffee and tea, which may, therefore, merely have acted as astringents, causing a retention of the urinary matters somewhat longer in the blood than in the state of health, without any reference to the disintegration of the tissues. (*Am. Journ. of Med. Sci.*, N S., xxxi. p. 338.)—*Note to the second edition.*

Experiments by Mr. Charles E. Squarey, a report of which was presented by Dr. Garrod to the Royal Medical and Chirurgical Society of London, render doubtful the statements above made, in relation to the effect of coffee in diminishing the excretion of urea. Mr. Squarey's conclusion from his observations, which were made on the human subject, was that coffee neither increases, nor, to an appreciable extent, diminishes the proportion of urea eliminated by the kidneys (*Med. T. and Gaz.*, Dec. 2, 1865, p. 618.) The researches of C. Voil, previously made, upon the effects of coffee on dogs, are of a similar bearing as to the diminution of the urea, which he found rather to be increased than otherwise. (*Am. J. of Med. Sci.*, Oct. 1862, p. 507.) Still stronger is the statement of Dr. Geo. Harley, who asserts, as the result of his own observation, that coffee directly increases the excretion of urea; and ascribes the contrary results of Böcker and Hammond to their probably having drank their coffee with sugar, which is well known to have the effect of lessening

I would attach a different explanation to them. It is difficult to conceive how stimulant medicines, which are acknowledged to increase the activity of the functions, particularly those of digestion and of the nervous system generally, can diminish the amount of organic change which takes place in the exercise of the functions. It is much more probable that these substances act by enabling the digestive organs, and others concerned in the conversion of the food into blood, to effect this conversion more thoroughly, and thus, not only to enable the system to do with less food, as the little which is used is thoroughly appropriated, but to diminish also the amount of excretion; because the food being converted more thoroughly into blood, is less wasted by those imperfect attempts at assimilation which only effect the change partially, and cause the remainder of the food to be thrown off in the form of urea. A proof of the correctness of this view is afforded by experiments of Dr. Böcker, which show that not only is the urea thrown off by urine diminished, but the amount of feculent matter discharged from the bowels is remarkably diminished also (*Ibid.*) Now it is much easier to conceive how a more thorough consumption of the food shall produce this diminution of feculent discharge, than that the same thing shall be effected by a reduction in the activity of the metamorphosis of the tissues in the nutritive process. Besides, it is the nitrogenous articles of food only to which the remark applies; and these are the very articles which alone can furnish urea by their imperfect conversion into blood or solid tissue. I believe, therefore, that, should this important result be verified, it would be really ascribable to the stimulant influence of the medicines upon the processes of digestion and assimilation, by which the nitrogenous food is more thoroughly converted into blood and consumed in nutrition, and consequently less of it escapes from the bowels undigested, and less from the kidneys, in the form of urea, in consequence of imperfect assimilation.* It is stated by Dr. Lehmann that, in persons following an active occupation, the use of an ounce of roasted coffee in infusion daily, reduces the daily waste one-fourth, and consequently diminishes, in the same proportion, the quantity of nitrogenous food necessary to health. (*Ed. Month. Journ. of Med.*, Jan. 1855, p. 9.) It is not at all improbable, that the highly nitrogenous caffein is itself decom-

---

the discharge of this principle. (*Med. Times and Gaz.*, April, 1864, p. 419.) At present, therefore, the question must be considered as undecided; but in no event can coffee be considered as exercising, in its immediate operation, a depressing influence on the nutritive process. (*Note to the third edition.*)

* Confirmatory of these views are the results of experiments by Dr. John C. Draper, which prove that muscular exercise does not materially increase the amount of urea in the urine; while an increase of food has this effect. (*N. Y. Journ. of Med.*, N. S., xvi. 167.)

posed, and made to contribute to the nourishment of the body; so that in this way also the necessary proportion of food is diminished.

In relation to the different actions of the several constituents of roasted coffee, Dr. Lehmann thinks he has proved that the empyreumatic oil is that which most powerfully contributes to the results just stated, while it operates as a laxative, diaphoretic, and diuretic, invigorates the intellect, and, in excessive doses, produces irregular mental action, restlessness, and insomnolency. Caffein he found, in excess, to occasion rigors, acute pulse, urinary disorder, headache, and delirium. (*Ibid.*, p. 314.) Experiments with caffein upon the lower animals seem to prove that it is poisonous in large doses. (*Ranking's Abstract*, No. 29, p. 286.)

The vapours from roasted coffee appear to have a powerful deodorising effect, not merely by covering the offensive smell, but by decomposing the effluvia in which it originates. (See *Am. Journ. of Pharm.*, xxviii. 183.) They appear also, when largely inhaled, to be capable of producing very serious effects on the nervous system. The cases of two soldiers are recorded by Dr. L. Traver, U. S. N., who, in consequence of smoking coffee as a substitute for tobacco, for a period of about ten days, were seized with a species of insanity. They either wandered about seemingly unconscious of what was going on around them, or sat as if in ruminating silence, starting with surprise when spoken to, staring at the speaker with a vacant and dejected look, and trembling with apparent apprehension of some evil to come. In consequence of their removal from the regiment, Dr. Traver lost sight of them, and was ignorant of the result. (*Med. and Surg. Reporter*, April 1, 1865, p. 406.)

Tea differs in its effects from coffee mainly in degree. It is less stimulant to the nervous system, less apt to oppress the stomach, probably quite as efficient as a tonic to the digestive organs, and more astringent in consequence of the amount of tannic acid it contains. Certain it is that tea, especially black tea, may be drank habitually with impunity by persons who cannot use coffee without suffering, and that it sits more lightly on the stomach. In febrile diseases, a cup of tea is often not only tolerated, but agreeable to the patient, and refreshing in its effects; while coffee, however much it may be relished in health, is usually repulsive to the patient in a fever, and not well accepted by the stomach or the system.

Therapeutic Application. Coffee and tea came into use in Western Europe about the middle of the seventeenth century. Unfortunately, their habitual use as articles of diet limits very much their therapeutic application. The system is so much accustomed to them, that their remedial influence can scarcely be felt, in ordinary doses.

There can be no doubt that, under other circumstances, they would be very serviceable in dyspepsia, the very disease of which, through their abuse, they are among the most frequent causes. Occasionally used, they would serve as agreeable tonics in these cases, in which they would also be recommended by their cheering influence upon the spirits, ordinarily so much depressed in that complaint. If, instead of using them at the morning meal, when the stomach and system are most excitable, we should restrict their employment to the close of dinner, as is done with coffee in France, they might prove serviceable by facilitating the digestion of the food, and rendering it less oppressive to the stomach, while their injurious influence on the nervous centres would be less felt.

Thus, too, to those who do not habitually abuse them, they would be found an admirable restorative in the exhaustion of excessive labour, mental or physical, and an excellent corrective of mental disquietude arising from morbid states of the system, or the vicissitudes of life.

In attacks of *nervous headache*, or of *sick-headache*, they often afford great relief to patients not insensible by habit to their effects; and even in those who have brought on habitual headache and nervous disorder by their abuse, they will often control temporarily the paroxysm of those affections if given very freely; just as ardent spirit will relieve, for a time, the horrors which have originated in its continued excess.

Their influence in producing wakefulness may sometimes be taken advantage of, in lethargic and soporose conditions of the system, with good effect. They have, with this view, been recommended in the stupor of low fevers; and a cup of tea occasionally given may prove useful in that condition; but coffee is usually too heavy upon the stomach, and might be injurious by disturbing that organ.

In *narcotic poisoning*, these medicines are obviously indicated. The stupor from this cause may depend either upon a direct sedative influence on the nervous centres, as from chloroform, or upon active congestion, as from opium, alcohol, belladonna, etc. In either case, coffee, as the stronger of the two medicines in its stimulant powers, may be usefully employed. In both cases, it relieves by its general diffusive stimulation of the nervous centres, causing a more equable distribution of the nervous force, thus supplying the deficiency in the one instance, and unloading the overwhelmed centres in the other. Experience has proved it to possess considerable efficacy in obviating the stupefying effect from poisonous doses of opium. Though it should never be relied on exclusively in cases of this kind, it may be used conjointly with other methods; and, after the evacuation of the poison, is among the best means not only of preventing stupor, but also generally of supporting the system in its tendency to collapse. It must, however, be given strong and freely to produce much effect. In the same way, it proves useful in dissipating slight effects from alcoholic liquors; and the habitual use of it, at the close of dinner, is sometimes advantageous in other methods than by promoting the digestion of the food.

In the *paroxysm of spasmodic asthma*, strong coffee often affords considerable relief. It should be given quite saturated, and in the dose of a cupful every twenty or thirty minutes.

In *hooping-cough*, too, it has been highly recommended, given at the close of each meal. It is only in children unaccustomed to its use that it could be expected to be beneficial; and in these it may at least be tried with the hope of advantage. The editors of the *Boston Medical and Surgical Journal* (May 16, 1861. p. 333) say that they have used it in several instances, with marked advantage. In one case, that of a girl six years old. the hooping ceased entirely after she had begun with the prepared coffee, of which she took a tablespoonful and a half. made very strong, three times daily.

I have heard of a case of ordinary *catarrhal or spasmodic croup*, in which it relaxed the spasm, and seemed to be the cause of cure.

In attacks of *nervous dyspnœa* and *palpitation of the heart*, coffee is said to have proved highly useful; and. though it might be deemed inadequate to the cure of so serious an affection as angina pectoris, it might be employed along with other measures, given as above recommended in spasmodic asthma.

It is asserted to have proved very useful in *strangulated hernia*. (*British Med. Journ.*, Nov. 1857. p. 926.)

Coffee has been found effectual in many cases of *intermittent fever*. Its strong influence upon the nervous centres, through which each paroxysm of an intermittent disease probably makes its approach. might be expected to endow it with a certain amount of antiperiodic power. In some parts of Greece. it is said by Dr. Pouqueville to be very successfully used in connection with lemon-juice. At least an ounce of the powder must be employed, in the form of decoction or infusion, between the paroxysms.

Other complaints in which it has been recommended are cholera infantum, diarrhœa, calculous affections, and amenorrhœa.

It has also been used to cover the taste of sulphate of magnesia, castor oil, sulphate of quinia, etc., which may be administered in it as a vehicle: but it is said not to be effectual for this purpose, unless the mixture is heated for a time to the boiling point.

Administration. Coffee may be used in medicine in the form of powder, decoction, or infusion. Of the *powder*, a drachm or two may be taken for a dose: but it is very seldom used in this way. The *decoction* may be made by boiling an ounce of the coarse powder in a pint of water for a short time, and then clarifying by the white of an egg. The *infusion* is best prepared by the process of percolation. A cupful of either may be given for a dose, and repeated, if necessary.

Caffein, in the form of *citrate*, has been recommended as a remedy or preventive of sick-headache, in the dose of a grain every hour, before or during the paroxysm. Caffein itself, in doses varying from two to ten grains, was found by Lehmann to produce vehement excitement of the nervous and circulatory systems, with palpitations, oppression of chest, headache, perversion of hearing and sight, sleeplessness, erections, and delirium. Prof. H. T. Campbell, of Georgia, administered twenty grains of it, dissolved in infusion of coffee, by enema, in a case of poisoning by laudanum in which the patient could not swallow, with the apparent effect of rescuing him from impending death. (*Am. Journ. of Pharm.*, xxxii. 321, from *South. Med. and Surg. Journ.* for May, 1860.)

Tea is always given in infusion. It is probably preferable to coffee, especially the green variety, when given very strong, as a preventive or cure of sick-headache. As a refreshing drink in febrile diseases it is also preferable, being much more agreeable to the patient and acceptable to the stomach. In diarrhœa, too, it might be expected to prove more effectual than coffee, through its astringency. In consequence of the tannic acid it contains, it might be used as an antidote to tartar emetic; and I have often employed it, on the same account, as a gargle in mercurial sore-mouth.

◆

There are several other substances which merit a brief notice here, either from former reputation, or from their greater or less efficiency, though at present not much employed as nervous stimulants, at least in this country.

1. RECTIFIED OIL OF AMBER.—OLEUM SUCCINI RECTIFICATUM. *U. S.*

Oil of Amber (OLEUM SUCCINI, *U. S.*), in its impure commercial form, is obtained from amber by subjecting it, mixed with sand, to dry distillation. A sour liquid comes over, on the surface of which a very dark-coloured oil floats, which is removed, and constitutes the crude oil of commerce. The rectified oil is obtained from this by distillation with water.

Rectified oil of amber thus obtained is of a light yellowish-brown or amber colour, a strong, peculiar, disagreeable odour, and a hot acrid taste. It is insoluble in water, but is dissolved by alcohol and the fixed oils. Exposed to the air, it absorbs oxygen, and gradually darkens and thickens, until at last it becomes black and solid. It consists, when pure, of carbon and hydrogen, but contains oxygen as found in the shops.

Medical Properties and Uses. Oil of amber is locally and generally stimulant, exciting both the circulation and the nervous system, and sometimes promoting the secretions. It has been employed in most of the diseases to which this class of medicines are considered applicable;

as tetanus, epilepsy, hysteria, hooping-cough, and the convulsive affections of children. It has also been given in amenorrhœa. The dose is from five to fifteen drops, which may be most agreeably given in emulsion, made with gum arabic, sugar, and one of the aromatic waters.

The oil has been used locally, as an antispasmodic liniment, rubbed on the skin along the whole length of the spine, in hooping-cough, and infantile convulsions. It has also been employed in chronic rheumatism and palsy, as a rubefacient. In the convulsions of children, connected with intestinal spasm, the late Dr. Joseph Parrish was in the habit of using a liniment composed of equal parts of this oil and laudanum, mixed with three or four parts of olive oil and brandy. It was rubbed freely along the spine. It is said to be a very efficient remedy for piles, applied locally to the tumours. (Prof. Procter, *Am. Journ. of Pharm.*, May, 1866, p. 217.)

2. DRACONTIUM. *U. S.*

This is the root of *Symplocarpus fœtidus*, or common *skunk cabbage*, an indigenous plant, with broad cabbage-like leaves, and a very fetid odour, growing in low meadowy or swampy places, throughout the northern and middle sections of the United States. The root should be collected twice a year, if possible, early in the spring and late in the autumn, should be carefully dried without heat, and then kept in closely-stopped bottles. It should not be kept in powder.

Properties. There are two parts of the root, the body and the radicles or rootlets, which are separated when collected. The body, as kept in the shops, is either whole or in slices. In the former state, it is two or three inches long by an inch thick, dark-brown and rough externally, and white and starchy within; in the latter, it is in circular pieces, which are transverse sections of the root. The radicles are of various lengths, about as thick as a hen's quill, flattened and wrinkled, white within, and invested by a light brownish-yellow epidermis.

The root has a peculiar, extremely fetid odour, which is strongest in the recent state, is retained, however, in drying, but gradually lessens, and at length disappears. The taste is acrid, and in like manner is injured by time. A boiling heat deprives the root both of smell and taste. These sensible properties are connected with one or more highly fugitive principles, which it has been found impossible to isolate, probably because they are destroyed in the process. Dr. Bigelow found that water distilled from the root was but feebly impregnated with the odorous principle, but was somewhat acrid, if the process were carefully conducted. It lost its acrimony, however, on standing a short time. (*Med. Bot.*, ii. 46.) The root is said to yield its virtues to water and alcohol. It should not be kept longer than a year for use.

Medical Uses. Dracontium is locally irritant, and, in its effects on the system, stimulant both to the circulation and nervous centres; and it is thought also by some to be expectorant. The Rev. Dr. Cutler, of Massachusetts, introduced it to the notice of the profession as a remedy or palliative in the *paroxysms of spasmodic asthma*, in which he had found benefit from it in his own person. Many practitioners have confirmed the statements of Dr. Cutler. Dr. Bigelow has seen a number of instances in which it proved useful in the *catarrhal affections of old people;* and Dr. Eberle gives similar testimony, from his own experience, of its effects in chronic cough "attended with a cold phlegmatic habit of body." (*Mat. Med. and Therap.*, 4th ed., ii. 154.) It is probably useful in these catarrhal affections mainly by its stimulant influence on the nervous centres of respiration. Dr. Thacher, in his Dispensatory, states that it has been found useful in *hysteria*, *hooping-cough*, *spasmodic pains*, *chronic rheumatism*, and *dropsy*. Dr. Heintzelman has used it, "with unequivocal benefit," in hooping-cough, in the spasmodic stage; finding it, when not successful in completely eradicating the disease, almost always to mitigate the severity of the symptoms. (*N. J. Med. Reporter*, iv. 310.) He has also used it advantageously in *phthisis*. There can be little doubt that it is a very efficacious nervous stimulant, when used in sufficient doses, and before its virtues have been impaired by time. As kept in the shops, it is often nearly or quite inert; and its great disadvantage is that, in the uncertainty as to its strength, it is impossible properly to graduate the dose unless it be quite recent. The practitioner in the country can always command it of full strength; for it is almost everywhere abundant in the low grounds.

The dose of the recently dried root in powder, to begin with, is from ten to twenty grains, three or four times a day. Dr. Bigelow found thirty grains of it to occasion vomiting, vertigo, headache, and dimness of vision. But it has been given in larger doses with entire impunity; and the probability is that different individuals are affected by it with different degrees of facility. The dose above recommended, if it produce no obvious effect, should be gradually increased till it does so, in order to determine the degree of its activity. It may be given also in strong cold infusion, in tincture, or syrup. The *infusion* should be made by percolation with cold water, in the proportion of an ounce of the recently dried root to the pint, and given in the commencing dose of half a fluidounce to an adult. An infusion, prepared in the same way, but of four times the strength, may be formed into a *syrup* with twice its weight of sugar, and given in half the dose. The dose of a *saturated tincture* is stated at one or two fluidrachms.

3. CYPRIPEDIUM. *U. S.*

Under this title, has been introduced into the U. S. Pharmacopœia the root of *Cypripedium pubescens*, one of several species, which, with the common name of *ladies' slipper* or *moccasin plant*, inhabit the woods in different parts of the United States. They are small perennial herbs, with beautiful and conspicuous flowers, which, from their peculiar shape, have given rise to the name by which the plants are commonly designated. The medical virtues of the different species are probably identical or nearly so, and several of them are indiscriminately employed. The root of the officinal species consists of numerous somewhat contorted radicles, four or five inches long, which unite in a common head or caudex. It has an aromatic odour, and a peculiar, sweetish, pungent, and bitter taste, and imparts its virtues to water and alcohol. These appear to consist in a moderate stimulant power, directed especially to the nervous system, which renders the root useful in various nervous diseases, as hysteria, hypochondriasis, morbid sensitiveness, neuralgia, etc. The dose of the powder is about fifteen grains three times a day. A resinoid matter obtained by precipitating the tincture with water, improperly called *cypripedin*, has been given in doses varying from half a grain to three grains. The medicine may be administered also in infusion; and a fluid extract would probably be an eligible preparation were the remedy much used.

4. SAFFRON.—CROCUS. *U. S., Br.*

The term saffron is, in common language as well as officinally, used to designate a product of the *Crocus sativus*, or common cultivated saffron, consisting of the convoluted stigmas and a portion of the attached style, separated from other parts of the flower. The plant is a native of Greece and Asia Minor, and is cultivated in most of the temperate regions of Europe, as well as in Egypt, Persia, and Cashmere. It is cultivated also in the United States, not only in our gardens as an ornamental plant, but to some extent, moreover, for medical use. The saffron, however, used in this country is generally imported; and most of it is brought from Gibraltar, Trieste, and other Mediterranean ports. As a medicine, it is so little valued as hardly to merit a place in a Materia Medica catalogue; yet it is still much used as an ingredient in various officinal preparations, especially tinctures, in which it was formerly supposed to perform an active part remedially, but in which it is now retained, partly because it adds a certain richness of appearance to these preparations, and partly from an unwillingness to disturb long established formulas. It is, therefore, an object of interest much more to the pharmaceutist than the physician; and I must content myself with referring, for its sensible and chemical properties, to the U. S. Dispensatory; merely stating here that it has a rich deep-orange colour, a sweetish, aromatic odour, and a warm, bitter, somewhat pungent taste, and yields all its virtues to water and alcohol.

It was formerly very highly esteemed as a medicine, and was supposed to possess extraordinary powers as an anodyne, antispasmodic, emmenagogue, etc.; but it is believed at present to have little remedial power of any kind. The most, probably, that can be said of it is, that it is a moderate nervous stimulant, and may possibly add somewhat to the efficiency of other remedies, with which it is combined chiefly in reference to its sensible properties. In domestic practice, it is sometimes used in the form of hot infusion, to hasten the appearance of the eruption, in certain exanthematous fevers, as measles and scarlatina, when from any cause delayed, or to restore it if suppressed.

An officinal *Tincture* (TINCTURA CROCI, *Br.*) may be used internally in the dose of one or two fluidrachms; but is employed mainly to give flavour and colour to other liquid preparations.

The dose of saffron itself is stated at from ten to thirty grains.

5. COCHINEAL.—COCCUS CACTI. *U. S.*, *Br.*

This, like the substance just treated of, is much more used for its sensible than for its remedial properties. Little, therefore, need be said of it here; but the reader will find it described, in relation to all its properties, in the U. S. Dispensatory. Cochineal is a dried insect, designated as the *Coccus Cacti*, because it inhabits different species of the genus Cactus and allied genera, especially the *Opuntia cochinillifera*, or *Nopal* plant of Mexico. It is from that country that cochineal is chiefly imported, though it and the plant on which it feeds are now cultivated in other countries, and especially the Canary Islands. The mass of cochineal consists of grains, which are the whole dried insect, irregularly round or oval, convex on one side, convex or flat on the other, about one-eighth of an inch in diameter, marked with transverse wrinkles, and either of a reddish-gray or blackish colour. It has a faint heavy odour, a bitter acidulous taste, and in powder a purplish carmine colour. When chewed, it stains the saliva intensely red; and it owes its chief value to a colouring principle, denominated *cochinilin*, which is of a brilliant purple-red, and imparts its colour to water, alcohol, and ether, all of which dissolve it. It is precipitated from its watery solution by various metallic salts, with the bases of which it forms insoluble compounds, of a rich red colour. The pigment called *lake* is a compound of cochinilin and alumina. *Carmine* is the colouring principle precipitated by the salts of tin.

In relation to its medicinal properties, cochineal may be slightly stimulant to the nervous system, and has been recommended in hooping-cough and neuralgia. In the former of these complaints, a liquid mixture containing cochineal and carbonate of potassa, was highly recommended by the late Prof. Chapman, of the University of Pennsylvania. It is more used, however, as a colouring agent than as a remedy. The dose for an infant is one-third of a grain three times a day.

The *Tincture* (TINCTURA COCCI, *Br.*), which, as directed in the British Pharmacopœia, contains the virtues of two and a half avoirdupois ounces in an Imperial pint (twenty fluidounces) of spirit, may be given in a dose of from twenty drops to a fluidrachm, but is chiefly used to give colour to liquid preparations.

6. COCA.

Though not recognized by the Pharmacopœias, and scarcely known in this country except as an imported curiosity, the substance thus named exercises over the system an influence so extraordinary, that it would be scarcely justifiable to pass it wholly unnoticed. It consists of the dried leaves of *Erythroxylon Coca*, a South American shrub, extensively cultivated in Peru, Bolivia, and other neighbouring countries, where its produce was in common use before the Spanish conquest. The leaves bear a considerable resemblance in size and form to those of the Chinese tea plants, and when dried have a somewhat similar odour. Their taste is peculiar, with some bitterness and astringency in decoction. Water and alcohol extract their virtues. Besides the ordinary constituents of vegetables, they have been found to contain a concrete odorous principle, tannic acid, and a peculiar crystallizable alkaloid, called *cocaina*, on which their virtues probably depend.

The effects of coca on the system appear to be of the same character as those of tea and coffee, though more powerful. It has an excitant influence on the nervous system, induces wakefulness, and supports the strength under an amount of physical exertion which would be impossible without it. The natives of Peru employ it habitually to invigorate them on the occasion of any unusual exertion, as in long foot-journeys in the mountains, where they act as porters, in the labour of the mines, etc.; and, while under its influence, they can support fatigue whole days, even without food, except at night. They carry with them, on such occasions, a bag of the dried leaves, which they chew continually. They who are accustomed to its use, like tobacco-chewers, suffer greatly from the want of it, and find it difficult, if not impossible, to break the habit when once formed; yet experience has not shown that it causes any great injury to the health, or in any appreciable degree shortens life. The amount consumed by an Indian daily, under the circumstances mentioned, is said by Dr. Reis (*Bulletin Gén. de Thérap.*, Fev. 28, 1866) to be from fifteen to twenty-five grammes (about four to six drachms). From the accounts of intelligent persons who have used the coca, it appears to exhilarate the spirits, invigorate the faculties both mental and physical, inspire courage, and, in fact, to be a powerful nervous stimulant, as this term is defined in the present work. In excessive doses, as thirty or forty grammes, for example, it excites the circulation, and induces a febrile condition, often attended with hallucination and delirium.

As a medicine, it would probably be found useful in most of the affections to which the nervous stimulants are applicable, and especially such as are benefited by the use of tea and coffee. In South America it has been employed successfully in the treatment of intermittent fever. An apothecary of La Paz has prepared a *sulphate of cocaina*, which is said to be analogous in antiperiodic powers to sulphate of quinia. (Fuentés, *Journ. de Pharm. et de Chim.*, Oct. 1866, p. 268.) Coca is most conveniently used in the form of infusion, made in the proportion of an ounce to the pint of boiling water, of which one-third or one-half, representing the virtues of three or four drachms of the leaves, may be taken daily.

CLASS III.

CEREBRAL STIMULANTS.

Syn. *Stimulant Narcotics.*

These are medicines which, to a stimulant influence over the circulation and nervous system generally, add a peculiar power over the special functions of the brain, as evinced, in their higher grades of action, by delirium and stupor. From their stupefying property, they have been called *narcotics*, derived from the Greek verb *ναρκεω*, which signifies to be or become torpid, dull, or stupid. But I do not think that the possession of this property is a sufficient basis for the formation of a class; for it belongs to medicines quite different and even opposite in their modes of operation, and therapeutic character. Thus, both opium and digitalis are capable of producing stupor; but the former is directly stimulant, and the latter directly sedative; and so opposite are they in their effects upon the system, that the former is one of the best instruments for controlling the excessive action of the latter. Besides, certain medicines, as alcohol and ether, have been generally excluded from the narcotics, though they act upon the brain with an energy scarcely inferior to that of any acknowledged substance of the class, and are both powerfully stupefying agents. I have thought it best, therefore, to abandon the old class of narcotics, and to arrange the medicines composing it according to their more important affinities; placing in separate categories the stimulating and the sedative, and merely retaining the word narcotic to express a quality, as we employ the terms *anodyne*, *soporific*, etc.

The only properties in which all the medicines of this class agree are those stated in the definition. In all other respects they differ among themselves, and some of them very greatly. *In the first place*, they differ very much in the degree of their general stimulant power. In this respect, alcohol and ether may be placed at one end of the scale, and henbane at the other; the two former medicines being among the most powerful stimulants in our possession, the latter having no more of this property than barely sufficient to justify its position in the class. *Secondly*, they differ in the degree in which they relatively affect different organs or functions. Thus, if we compare alcohol and opium, we shall find that the former has a greater proportional influence in stimulating the heart and arteries, the latter in stupefying the brain. *Thirdly*, they differ in the manner in which they affect precisely the part or organ upon which they operate. The symptoms of cerebral disturbance produced by alcohol are unlike those resulting from the use of opium; and both differ materially in this respect from belladonna. *Fourthly*, there is, for the most part, in each one of them, a characteristic mode of affecting some function apart from their general action as cerebral stimulants. Thus, opium produces constipation of the bowels, hyoscyamus often acts as a laxative, and belladonna occasions a characteristic dryness and irritation of the fauces.

In some measure, this difference of action may be accounted for by supposing, that the influence of the several articles of the class is directed more especially to some one portion of the brain rather than to another, though all parts may be more or less affected. Thus alcohol, from its peculiar influence on the voluntary movements, and the powerful stimulation it exercises upon the sexual propensities, may be supposed to operate more especially on the cerebellum; opium, from its great stupefying power, to act on the cerebral lobes with peculiar energy; belladonna, from its property of impairing vision, to have a more immediate influence on the optic thalami or corpora striata. But too little is yet known of the precise functions of different portions of the encephalon, or of the phenomena by which influences upon them respectively could be recognized, to justify any very decided opinion upon the affinity which the several cerebral stimulants may have for particular parts of that structure.

The difference in the effects of cerebral stimulants on the pupils is a striking point of diversity between them, which has attracted much attention, but which only recent discoveries in relation to nervous action enable us partially to explain. Thus, while opium often contracts the pupil, belladonna much more strikingly produces dilatation. This has been considered as evincing an essential antagonism between those two narcotics. It only proves that, in reference to this particular effect, they either act differently on a special nervous centre, or in like manner on different nerve centres with which these phenomena are connected; while, as regards their general action, there may be no antagonism whatever. Thus, supposing the radiating fibres of the iris to be excited by the sympathetic nerve, and the circular by nerves from near the base of the brain, as the third or fifth pair, and these forces to balance each other in the normal state, it follows that whatever excites the sympathetic centre in the medulla oblongata, or paralyzes the basic centres referred to, will produce dilatation of the iris, while a paralyzing influence on the sympathetic centres, or one of an excitant character on the others, will equally produce contraction; so that, while two cerebral stimulants differ in their mode of affecting these special centres, they may correspond in their effects on the remainder of the cerebro-spinal axis, or while one acts on one of the centres, and the other on the other, they may both act in the same manner, and with the same effect, that is, may both be excitant, or both depressing.

Though differing so much among themselves, there are affinities between certain articles of the class, which might serve to arrange them in subdivisions, having, to a considerable extent, a common therapeutic basis. They might thus be arranged in groups, of which one would contain alcohol and ether, another opium, extract of hemp, lactucarium, and hyoscyamus, and a third belladonna and stramonium; the other individuals of the class remaining isolated. By considering them successively according to these relations, we may, sufficiently for practical purposes, fix in the recollection of the student the resemblances referred to.

Before proceeding to a general account of the mode of operation, and therapeutic properties of the class, it will serve to prepare the way, if we dwell for a short time on certain peculiarities in cerebral pathology, which, if not understood, will inevitably lead into great confusion. It is a well-established fact, that opposite morbid conditions of the brain, or parts of it, express themselves by similar phenomena; and the law probably holds true of the nervous centres universally. Pain and other morbid sensations, spasm and other forms of irregular muscular action, delirium partial or complete, mild or severe, chronic or acute, and every grade of stupor, from slight drowsiness to the deepest coma, may all arise, and frequently do arise, from the two opposite affections of irritation and depression of the cerebral centres. For proofs of this, and for an explanation, which, in the opinion of the author, may serve to reconcile the apparent contradiction, readers are referred to the article on functional diseases of the brain in his work on the Practice of Medicine. It would occupy more space than could be spared to repeat them here. But the application of this fact to the subject now before us is of great practical importance. From a certain similarity in their obvious effects, medicines essentially different in character have been associated together in the minds of writers and practitioners, and been considered as nearly identical in nature, so that they might be interchangeably employed under the same circumstances, without disadvantage. Now, as opposite morbid causes, acting on the same cerebral centres, may produce the same morbid phenomena; as, for example, insufficiency and excess of blood in the brain may either of them produce delirium, coma, and convulsions; it follows necessarily that medicines, which in excess are always morbid causes, may also, though really opposite in character, give rise to closely resembling, if not identical symptoms. Thus, of the medicines usually ranked together as narcotic, because they produce the common effect of stupor, some operate as direct stimulants, others as direct sedatives to the nervous centres; and it will be readily understood that, if such medicines are used remedially, under the impression that they are identical in character, the most serious consequences might ensue. Opium is stimulant to the nervous centres, aconite is sedative; but both in over-doses are capable of producing coma. In a case of active congestion of the brain, in which the latter may be useful, the former could do only injury; and *vice versa*. To administer them, therefore, indiscriminately, because of their common stupefying effect, would be a grievous error. But a case more in point, because there is reason to think that attention has not yet been sufficiently called to it, is that of ether and chloroform. Both of these are powerful anæsthetic agents; and, under the impression that their mode of action is essentially identical, they have been used and recommended in similar cases, with little discrimination. The one is, in fact, a most energetic cerebral stimulant, the other an equally powerful cerebral sedative: is it, therefore, surprising that, used indiscriminately, one of them at least should have occasioned so fearful an amount of mortality? The importance of guarding against such a therapeutic error is, it appears to me, an irrefragable argument in favour of the division I have made of the narcotic medicines into classes, founded not on phenomena which are readily misinterpreted, but on their real physiological influence on the brain, and the general system.

Effects on the System. The first effect of a cerebral stimulant, given in doses calculated to bring its characteristic influence into operation, is more or less to excite the stomach. In a short time, its influence extends to the general system, showing itself usually, in the beginning, by a moderate increase in the activity of the sensorial functions, and in the movements of the heart. But very quickly more obvious cerebral phenomena are exhibited; while the circulation may or may not be proportionably excited. The sensorial functions are now perverted. Abnormal sensations are felt in the head, such as fulness, pressure, confusion, swimming, giddiness, singing in the ears, perhaps pain; the mind wanders more or less; the voluntary movements are apt to become irregular; and intoxication or delirium may supervene. Next succeeds a gradual diminution of the sensorial functions. Heaviness and languor, or a feeling of general and pleasing calmness, soon deepens into drowsiness, and this at length into stupor, which more or less closely resembles natural sleep, according to the character of the narcotic used. All these are the direct effects of the medicine. The stupor continues for a length of time varying from one or two to twelve hours or more, according to the particular article used, gradually diminishing from its greatest intensity, till the patient at length becomes fully awake, when the direct operation of the medicine is passed. But now a condition of depression takes place, more or less corresponding with the previous excitement, and the strength of the direct impression. This is characterized by feelings of languor and dejection, often with more or less general or local uneasiness, especially headache, by a pale, cool, and relaxed state of the surface, and feebleness of the pulse, and by a depressed state of the gastric functions, as indicated by want of appetite, nausea, and perhaps vomiting. These symptoms may be so slight as to be scarcely noticed, or they may be severe and extremely uncomfortable to the patient, but from appropriate doses are seldom serious. After a few hours they gradually pass away, under healthy vital influences, and the previous state of system returns with little or no appreciable change.

From larger doses of the medicine, the primary excitant impression is stronger, but shorter, the succeeding period of stupefaction deeper and more lasting, and the secondary depression greater, more protracted, and more serious.

In very large quantities these medicines become poisonous. The symptoms of excitement and exhilaration, though sometimes intense, are very brief, and the subsequent stupor profound and alarming. Instead of being confined mainly to the cerebral centres, the influence of the poison extends to the centre of respiration in the medulla oblongata, which may be overwhelmed by the force of the poison, and death may result from this cause. Or the direct effects of the narcotic may pass over without fatal consequences, and the patient may lapse into the secondary condition, and perish from the universal prostration of his functions. If the dose of the poison has not been quite sufficient to destroy life, he rises slowly and with difficulty from the profound depression, and may not for several days recover his previous state of health, perhaps even for a much longer time, if any organic lesion shall have taken place.

The course of the symptoms has been given above: but they require explanation. First, it may be proper to observe that the description is applicable only as a general rule. Special phenomena are sometimes exhibited by the individual narcotics, which it will be most convenient to treat of along with their other properties and effects.

The first impression on the stomach is due to the direct contact of the medicine, which operates both on the nervous and vascular tissue of the organ, exciting it to an increase of function, which is followed by the same stupor, locally, if we may so express ourselves, as that experienced by the general system. It is not impossible that the original gastric excitation may be sympathetically propagated to the cerebral centres, giving rise to the first phenomena of general stimulation, and afterwards increasing the direct influence of the medicine when it reaches the brain through absorption: but we have no positive evidence to this effect: nor indeed have we, in relation to some of the narcotics, any demonstrative proof that they are absorbed at all. But, as some of them are known to be so, the inference is quite allowable that they are all taken into the circulation, or at least their active principles: and it is most probable that their constitutional effects are chiefly, if not exclusively, produced in this way.

The impression of the medicine on the cerebral centres is probably throughout, so long as its direct influence remains, of a stimulating character. That it is so at first, is rendered obvious by the symptoms. Some have ascribed the stupefaction which ensues to a sedative operation. I cannot agree with them. I cannot conceive that a medicine, in its direct influence on an organ, shall pass so speedily from a stimulant to a sedative action. A true sedative condition will result, but that is after the medicine has ceased to act directly. It is not difficult to explain the occurrence of intoxication and stupor upon the principle of continued stimulation. I have demonstrated elsewhere that, in the continuous operation of an excitant directly upon any organ, the first effect is an increase, the next a derangement, and the last a depression or suspension of its function. These results probably follow the gradually increasing amount of blood drawn into the organ by the irritation, at first in quantities merely sufficient for the support of the increased function, afterwards sufficient to derange it, though still increased, and lastly congesting the organ to a point at which its function is embarrassed and impaired, or quite overwhelmed. Applying this general rule to the operation of the cerebral stimulants, we have first the simple excitation, as shown by the obvious phenomena; next, the perverted excitation, exhibited in the mental confusion, or intoxication; and thirdly, the overwhelming congestion, as evinced by the drowsiness and stupor. But when the immediate operation of the medicine has ceased, either in consequence of its decomposition or elimination, the stimulated organ is left to its own powers. Its excitability having been exhausted by the previous over-action, it is insusceptible to the ordinary healthful influences of the blood and other vital agents, and consequently acts feebly, or for a time ceases to act. Hence the prostration which follows the cessation of the direct operation of the medicine. The exhausted organ, however, if not fatally depressed, recovers its excitability by rest, and, being again able to feel and respond to its healthy stimuli, returns to its normal state of action. When poisonous quantities have been taken, death occurs in one of two ways. Either a nervous centre essential to life, as the respiratory centre in the medulla oblongata, is so far overwhelmed by the active congestion as to be unable longer to perform its office, in which case the function of respiration ceases as a necessary consequence; or the general depression following the enormous preceding excitement of the cerebral centres generally, and of the whole system, is too great for reaction, and the patient dies completely prostrated. In the former case, which is by far the most common, the respiration ceasing, the blood is no longer oxygenated in the lungs; the capillaries consequently refuse to carry it forward; the heart, failing to receive a supply necessary to the support of its function, now in its turn ceases to act; and death takes place finally because the blood no longer circulates. In proof that the above is the true explanation of the operation of the cerebral stimulants, dissection after death always shows congestion of the brain, when the patient has not died of pure prostration after the poison has ceased to act.

Death, then, from the cerebral stimulants is usually an example of asphyxia. The heart, as in the same affection from other causes, continues to beat for a short time after respiration has ceased, sometimes in a greater or less degree for five minutes, thus affording the opportunity for the employment of recuperative measures, even after apparent death. Brodie first proved, by experiments on the lower animals, that, after apparent death from a narcotic poison, life might be saved by artificial respiration. The blood, being thus supplied with oxygen, begins again to move onward; and the heart, which has not yet quite ceased to beat, receiving a due supply, resumes its normal action, and the phenomena of life return. All that is necessary now is to continue the artificial respiration, until the nervous centres shall be in a condition to resume their function, and to support the strength of the patient against the secondary prostration. In several instances, these measures have been successful in the preservation of human life.

The cerebral stimulants are capable of producing their characteristic constitutional effects, to whatever part of the body they may be applied; a fact which strongly corroborates the idea of their operation through absorption. Of the ordinary avenues by which they are introduced into the system, with a view to remedial effect, they operate most speedily through the subcutaneous areolar tissue or lungs, next through the stomach, and after this through the rectum, or the skin deprived of the epidermis; and the duration of their effect is usually inversely proportionate to the rapidity with which it is induced.

The local effects of the cerebral stimulants upon the surface of application are analogous to their general effects, probably through their direct action upon the vessels and nerves of the part. They first excite the actions of the part, then diminish its sensibility, and lastly leave it, upon their removal, in a somewhat depressed condition; unless, indeed, their first stimulant impression shall have been sufficient to induce a positive inflammation, which will complicate the result.

This class of medicines, more rapidly than perhaps any other, lose their effect upon repetition. Each successive stimulant impression serves, in some degree, to lessen the excitability of the organs acted on; and, if time is not allowed for the system to recover its normal state before a renewal of the impression, this diminution of the excitability must be constantly and steadily continued. To produce a given effect, the dose of the medicine must be increased *pari passu* with the diminution of the excitability; and there are no fixed limits within which this augmentation is restrained. As the medicines have no corrosive effect, and therefore do not directly destroy the organization of the parts on which they act, the quantity which an individual may attain the ability to support, with present impunity, is enormous. In Dr. Chapman's Therapeutics the case of a woman is mentioned, affected with cancer of the uterus, who took three pints of laudanum, besides a considerable quantity of opium daily, enough probably to kill from fifty to one hundred healthy individuals. (2d ed., ii. 236.)

But the protracted use of the cerebral stimulants in excess is often attended with the most deplorable consequences in the end. As before explained, under the head of the Tonics, there are two great evils flowing from this abuse; *the one*, a gradual wearing out of the excitability of the system, and a consequent gradual depression of its functions and powers; *the other*, the production finally, in some one or more of the organs upon which the stimulant specially acts, of a low chronic inflammation, the result of the incessantly repeated irritation. This complication of general debility with local disease almost necessarily destroys life in the end, if it be not previously cut short by the occurrence of some accidental affection, which the exhausted frame is unable to support. More will be said on this point when the particular cerebral stimulants are treated of, which are most liable to be thus abused.

When the system has become habituated to one of these stimulants in great excess, its sudden withdrawal is sometimes followed by the most alarming prostration; and this is a fact which it is highly important to bear in mind, in the treatment of the diseases of individuals who are the victims of such self-indulgence. Even in their inflammatory affections, when depletion may be necessary to save life, though the habitual stimulant may be lessened, it should not be altogether withheld.

When called to a patient suffering under the effects of the abuse here referred to, the only remedy is the total abandonment of the evil habit. But this should, if possible, be effected gradually. Should the patient be under his own control, and unable or unwilling to persist in such a course of gradual reduction, the best substitute is to throw aside the particular stimulant abused at once and completely, and to support the strength by other stimulants of analogous powers, but less injurious in their effects, and possessing less attractions for the patient; then gradually to diminish the amount of this support, and ultimately withdraw it altogether.

Therapeutic Application. The therapeutics of this class of medicines will be most conveniently treated of under the several individual articles; as there is so much specialty in their uses, that few general observations would be applicable to the whole, or even the greater number. There are, however, a few considerations which it may be proper to present in this place, to spare inconvenient explanations and useless repetition hereafter.

General Stimulation. Among the cerebral stimulants are medicines which are most powerful and most relied on under circumstances calling for the most vigorous support to the depressed or exhausted system. In consequence of the universality of their stimulant power, and especially of their influence over the functions of the brain, the due maintenance of which is essential to life, they are better adapted than any other class of medicines to diseases of debility, in which these functions may participate in the general prostration. The only circumstance which contraindicates their use, and which might preferably direct the attention to other stimulants, is the existence at the moment, or the probable occurrence at the period of reaction, of active congestion or inflammation of the brain.

Relief of Pain, Spasm, etc. Besides general stimulation, they are much employed for the *relief of pain*, the *relaxation of spasm*, and the *composure of nervous irritation generally.* All these effects they produce by rendering the nervous centres insensible to impressions of an irritant character, and incapable of radiating influence from themselves. It must be remembered, however, that, in thus operating, they stimulate the centres instead of depressing them. Their influence comes under the general law already referred to in these preliminary remarks, namely, that irritation of an organ, in its highest grade, diminishes or depresses the function of that organ, probably by overloading it with blood. When the sensorial centres are thus stimulated, the impression sent to them from the suffering part is no longer felt, and pain of course ceases. Or, if the pain originated in disordered function of the centre itself, the feeling is equally abolished; because the function itself is temporarily suppressed. The same explanation applies to spasm and other forms of nervous derangement. If they originate in external irritation transmitted to the sensorium, they are relieved when the sensorium can no longer feel the irritation; if in disorder of the sensorium itself, they cease temporarily with the cessation of its function. But it frequently happens that pain, spasm, and other nervous disorder, originate in a depressed condition of the nervous centre; perhaps in a deficiency of its supply of good blood. The centre, under these circumstances, becomes a negative point towards which nervous force may be supposed to flow from the periphery corresponding with it, which suffers from the loss, and exhibits that suffering in one of the modes alluded to. The cerebral stimulants meet the indication here precisely. They sustain the depressed centre by a direct excitation, and by supplying it with good blood, when this is to be had, and sometimes even when it may happen to be wanting; for they often serve, by stimulating the blood-producing functions, to improve its character, and increase its quantity. But of course the cerebral stimulants are altogether unsuited for the relief of disordered nervous phenomena, when dependent on active congestion or inflammation of the brain itself. No one but a homœopathist would think proper to prescribe alcohol or opium in acute cerebritis or recent apoplexy; and the homœopathist himself, in doing so, escapes the crime of manslaughter only by the absolute nothingness of the dose.

The term *anæsthesia* has been applied to the loss of sensation under the influence of narcotic medicines, and *anæsthetics* to the substances capable of producing it. By some writers the anæsthetics have been raised to the dignity of a class; and if we regard symptoms or obvious effects simply as the basis of classification, such an association would be altogether proper; but I have elsewhere given my reasons for considering such a plan as very defective, of which the strongest is that similar symptoms are often produced by medicines wholly different in their essential mode of action, and a class founded on this basis must often include medicines which are, in other respects, wholly different, and consequently endanger serious errors in practice. Thus, anæsthesia may result from cerebral stimulants or cerebral sedatives, from excess of cold, from mechanical compression, and various other agencies, directly or indirectly, which could not, I think, be thrown together on any just basis of arrangement. After considering, however, the different agents used for their anæsthetic effects in the several classes to which they properly belong, it may not be amiss to enumerate them together, and thus recall them to the mind of the student in relation to their very important practical purpose; and I shall probably pursue this course before dismissing their consideration altogether.

Production of Sleep. This is another purpose which some of the cerebral stimulants are, beyond all other medicines, calculated to fulfil. They produce the effect, in all probability, simply by so congesting the sensorial centres as temporarily to suspend their sensibility to impressions, and their power of action. Sleep necessarily ensues, and is more or less profound, according as the centres are more or less deeply affected. It will be remembered that the congestion is, in these cases, merely the result of a stimulation of the centres inviting the blood into them, and may occupy, therefore, only the minute portions of cerebral matter of which the proper centres may possibly consist; differing altogether from the universal congestion caused by forces driving the blood into the brain, or by obstruction preventing its return. Sleep may equally be produced by influences on these same centres, depressing them below the point of impressibility or of action, as is probably the case with chloroform. This, too, is probably the source of sleep in health; the centres ceasing for a time to act, under the loss of excitability, temporarily exhausted by their activity in the waking state.

But several of the cerebral stimulants produce the therapeutic effects referred to in the last two paragraphs, in the manner of the nervous stimulants or antispasmodics, and in doses too small to give rise to their characteristic effects upon the brain. Pain, spasm, etc. are thus relieved by them, not by rendering the nervous centres insensible to impression, but probably by equalizing the excitement, the disturbance in the balance of which has occasioned the disorder. In producing sleep, their effect, thus given, is wholly different from their ordinary and characteristic operation. It is only when rest is prevented by nervous disturbance, that they are capable of acting in these small doses. The patient sleeps because the disorder which interrupted his rest has been relieved, not from the direct impression of the medicine on his nervous centres. A little paregoric, two or three grains of camphor in solution, or half a teaspoonful of Hoffmann's anodyne; doses which would have scarcely an observable effect in health, will often have this composing influence in disease.

Different names have been conferred upon articles of this class, expressive of certain effects produced by them; as *narcotics* because they stupefy, *anodynes* because they relieve pain, *anæsthetics* from producing insensibility in general, and *soporifics* or *hypnotics* from causing sleep.

I. ALCOHOL.

I propose first to give a general account of alcohol, its effects, and medical uses, and afterwards to treat of the forms in which it is used, and of what may be peculiar to each.

Alcohol is the product of a chemical process denominated *vinous fermentation*, by which, at a temperature between 60° and 90° Fahr., and with the aid of a nitrogenous material called *yeast* or *ferment*, sugar, either contained in certain vegetable juices or infusions, or dissolved in water, is converted into alcohol and carbonic acid, the latter of which escapes with effervescence. The liquids thus prepared, containing the newly-formed alcohol, are called *fermented liquors*. Many of them are employed in medicine, especially wines and malt liquors. When these are submitted to distillation, the alcohol comes over mixed with a considerable proportion of water, and a small proportion of other volatilizable matter contained in the liquid employed. The liquids thus distilled are called *ardent spirits*, of which there are numerous forms, varying with the character of the fermented liquor from which they are prepared. Among them are *brandy*, *rum*, *gin*, and *whisky*, all of which are occasionally used in medicine. By subjecting the ardent spirits to another distillation, or as the process has been called, to rectification, the alcohol comes over with much less water, and a smaller amount of other impurity, and now constitutes *rectified spirit*, or, as it is named in the U. S.

Pharmacopœia, simply ALCOHOL. It must be noticed, however, that this is not pure chemical alcohol, but still contains water, and has the sp. gr. 0.835. It is the strongest alcoholic liquid recognized in our officinal code prior to the last revision, when a more concentrated preparation was introduced, with the title of ALCOHOL FORTIUS, or *Stronger Alcohol*, for use in certain pharmaceutical processes. This has the sp. gr. 0.817, and is still far from being pure alcohol; but there is little or no occasion for anything stronger, for the use of the apothecary. As a chemical agent, however, it is sometimes necessary to have a still purer alcohol, which can be procured by further distillation; and, if quicklime be added to the liquid before it is distilled, all the water is retained, and alcohol comes over quite free from that liquid. This is called *pure, absolute,* or *anhydrous* alcohol.

Of *pure alcohol* it is only necessary to say that it is a colourless, volatile, inflammable liquid, of the sp. gr. 0,794 at 60° Fahr., of an agreeable pungent odour, and a burning taste, capable of combining in all proportions with water and ether, and composed of 4 equivalents of carbon, 6 of hydrogen, and 2 of oxygen. The latest view, and the one now generally received, of its precise chemical constitution, is that it is a hydrated oxide of a compound radical called *ethyl;* in other words, consists of 1 equivalent of ethyl (C_4H_5) and 1 of oxygen, combined with 1 eq. of water.

1. *Effects on the System.*

The following observations have reference to alcoholic beverages in general, and not to any one distinct form; but the effects described are to be understood as exclusively those of the alcoholic ingredient. When any particular fermented or distilled liquor has peculiar properties, independently of the alcohol it may contain, these will be mentioned when the liquor itself is treated of.

Alcohol appears to be a universal stimulant. It excites the part to which it is applied, the circulatory and nervous systems, the digestive, nutritive, and reproductive functions, and, under favourable circumstances, the various secretions; but its most powerful and characteristic effects are those produced upon the brain. Bernard has shown that it increases the formation, by the liver, of the material out of which sugar is generated in that organ. (*Arch. Gén.*. Juin, 1856, p. 735.)

Local Effects. When applied, sufficiently concentrated, to the skin or mucous membranes, its immediate effect is to induce paleness, with more or less pain, according to the sensitiveness of the part; after which the blood-vessels expand, heat and redness are produced, and sometimes inflammation. If the application be continued for some time, the tissue shrinks, and becomes wrinkled and hardened, in consequence, as some suppose, of the affinity of the alcohol for moisture, which it is thought to abstract from the part, or of its property of coagulating albumen and fibrin, which are thus solidified in the tissue. It certainly has been proved by Orfila, when thrown in considerable quantity into the veins of the lower animals, to coagulate the blood; and, when injected into the cellular tissue, to produce the same effect in the neighbouring blood-vessels. But, in the former instance, it is brought into direct contact with the blood, so as to exercise all its chemical influence upon the albumen and fibrin of that fluid; and, in the cellular tissue, it easily penetrates the extremely tenuous walls of the capillaries, and is in like manner enabled to act, in a concentrated state, directly upon the blood. Its influence in these cases is chemical; and, in general, death in the one case, and local death in the other are the consequences. But in its condensing or solidifying action upon the skin, we have no proof of any chemical agency. It probably simply increases the vital contractility of the tissues, in the same manner as the astringents. The surface is thus rendered more capable of resisting injury, which would scarcely happen if its organization were impaired. It is a common mode of preventing bed-sores, to wash frequently the parts liable to pressure with brandy, or other form of ardent spirit.

General Effects. When taken into the stomach, alcoholic drinks produce a feeling of warmth in the epigastrium, which is soon followed by increased frequency and force of the pulse, heat and flushing of the face, brilliancy of the eyes, and a characteristic sensation in the head; a sort of slight swimming or giddiness, which serves as a warning to the prudent not to allow the effects of the stimulant to proceed further. The spirits are at the same time exhilarated; there is a more rapid flow of thought and fancy; and increased energy is given to any emotion or passion that may predominate. There is, too, in general, a greater disposition to give expression to the thoughts and feelings of the moment; the restraints of modesty or timidity are removed; the tone of voice becomes louder and more energetic; and the limits have been approached, which cannot be transgressed without hazard. Beyond this point, if the drinking be continued, the control over the judgment is lost, and latent feelings are betrayed, or new ones arise, which are by no means always creditable. Persons, however, are very differently affected. Some are cheerful and good natured, others disposed to a fondling friendliness of manner, others, again, positive, domineering, or disputatious; and expressions are often used, or offence taken, in the excitement of the moment, which not unfrequently lead to the most sad results. The thoughts can now no longer be commanded. The ideas become confused, fancies are changed into realities, and various delusions are apt to occur, which often lead to corresponding acts. It is in this state that the absurd follies, or deplorable violences are perpetrated, with which the annals of drinking teem. The species of delirium entitled *intoxication* has now come on. In common English, the individual is drunk. Not unfrequently the senses are perverted in this condition; and double vision is one of its well-known characteristics. With all this cerebral disturbance, there is continued vascular excitement, the secretion of urine is generally much augmented, and the sexual propensities often powerfully stimulated, especially in the earlier stage. At the commencement of intoxication, the control of the will over the muscles begins to be impaired; and, after a time, it is quite lost. Each muscle may contract regularly; but the associated action necessary for the attainment of any particular object cannot be commanded. Hence the staggering of drunkards, their zigzag movements, the frequent tumbles, and often vain efforts to regain their feet. At length, the disordered functions gradually subside into insensibility; first heaviness and vacancy of expression come on, then drowsiness, and lastly deep sleep or a sort of coma, from which, however, the patient may generally be roused more or less completely. If he cannot be roused, he is vulgarly said to be *dead drunk*. The pulse subsides along with the nervous excitement, but, though slow, remains often full, and of a certain strength, such as characterizes compression of the brain. The sleep or insensibility continues for several hours, perhaps from six to ten on the average; and, during this period, the pulse gradually declines in strength, the skin relaxes, and not unfrequently copious perspiration takes place. The awakening is attended with headache, general uneasiness, and feelings of languor and depression; the pulse is feeble, and the skin cool and relaxed; and a want of appetite, often nausea and vomiting, clamminess of the mouth, and a furred tongue evince depression of the digestive organs following their great excitement. This condition passes off gradually; and, under the influence of cool water, fresh air and exercise, and the usual appliances of health, the system recovers its tone; and, in the course of a day or two, no traces of the debauch may remain, except, perhaps, the feeling of degradation.

Now and then, instead of the series of phenomena above presented, nausea and vomiting come on at some period in the progress of the debauch, and the further development of the symptoms is prevented. The patient goes to bed, and sleeps off the effects of the stimulant.

If the drinker have the prudence to cease before other cerebral disturbance is produced than the slight swimming of head alluded to, the excitement of system will gradually subside, perhaps with a copious diuresis, and there will be little observable depression afterwards. Should he, however, repeat the potation every day, he will, after a time, begin to find that, as the period approaches for recurring to the stimulant, there are feelings of uneasiness and of a want to be supplied, which are the inevitable penalty of over-indulgence; and there is always some danger, under these circumstances, of the formation of a very pernicious habit.

Every day, more and more will be required to relieve the uneasiness, and produce feelings of exhilaration; and, if the temptation to increase the quantity is yielded to, the power of resistance gradually diminishes, and confirmed intemperance ensues. The only preventive of this course of deterioration, when once entered upon, is to break off the use of the drink altogether, or to fix positive limits for the quantity daily used, which shall not be exceeded; and this quantity should not be large enough to produce sensible exhilaration. The former plan is much the safer.

The moderate use of these drinks, when a certain limit is never exceeded, and this falls short of obvious cerebral excitement, may be continued by many persons for a lifetime without serious injury. The system accommodates itself to the stimulus, which enters into the regular means of life, and no observable difference will be noticed between such an individual and another of the same natural constitution who is abstemious, except that the former, when from any cause diseased, has probably somewhat diminished powers of resistance, and stands more in need of artificial support.

But, if carried to the borders of intemperance or beyond them, the stimulant soon makes itself felt, in an individual before healthy, by an increased vigour or at least activity, of the digestive, assimilative, and nutritive functions. More and perhaps richer blood is made out of the same quantity of food, and the system passes into a plethoric condition, as shown by the fuller and stronger pulse, and the general redness of the surface, especially of the face. At the same time, the increased fulness of habit, and weight of body, prove that the nutrition has been promoted equally with the other processes; and in fact all the functions of the organic life are in a higher state of activity. This condition of things may continue long, in a constitution originally well balanced, without serious injury; and the individual may think himself in a high state of health. He is, however, on the brink of disease, and the slighest accident may precipitate him into it. If a considerable excess is maintained, the countenance, instead of the ruddy hue and fulness of health, assumes a deeper tint and a bloated appearance; and the signs of an excessive indulgence become obvious even to the most unobservant.

Poisoning by Alcohol. Every serious injury to the health, resulting either from a temporary debauch, or from the habit of drinking alcoholic liquids to excess, I consider as falling strictly under this head. First I shall treat of the acute, and secondly of the chronic poisoning.

Acute alcoholic poisoning is that in which life is endangered by large quantities of the stimulant taken at once, or in successive portions at short intervals, so that the conjoint effect is felt at the same time.

Sometimes, in such cases, death is almost instantaneous. Orfila, in his Toxicology, mentions two instances of this kind. Two soldiers drank, each, four litres (eight pints) of brandy. One died immediately, the other while they were bearing him to the hospital. It is probable that, in such cases, death results from an overwhelming impression on the stomach, affecting the brain sympathetically; and that the symptoms are those of great prostration from the first.

But such instances are extremely rare. Generally there is a brief excitement, followed speedily by coma, from which, when the result is fatal, death usually takes place at a period varying from twelve to twenty-four hours. The symptoms differ considerably in different cases. In some, the coma is so profound that the patient can be made to show no signs of sensibility or intelligence; in others, he can be partially and temporarily roused. The pulse is usually slow and full, sometimes natural as to frequency, but towards the close extremely feeble, and at length imperceptible. The respiration is also slow. The face may be flushed, with a venous hue, or may be pale. The pupils, though occasionally contracted, are more commonly dilated. Complete immovability of the pupil is an unfavourable sign. Convulsions are rare. Death results from the suspension of the respiratory process, either through the direct alcoholic congestion, or the secondary prostration of the nervous centres in the encephalon. When recovery takes place, as the affection was functional, the patient, upon the disappearance of the coma, returns to health, after a short period of secondary depression, with an aggravation of the symptoms already mentioned as characterizing the same stage in an ordinary debauch.

Another mode of acute alcoholic poisoning is by the *supervention of apoplexy.* This generally occurs in persons predisposed to that affection. In such cases, even a comparatively moderate indulgence may produce this effect by determining blood to the brain. It is no very uncommon event for persons thus predisposed to be attacked at the table. But occasionally the result is to be ascribed purely to the alcohol. The quantity of blood thrown into the brain produces a general congestion of the organ, and sometimes positive sanguineous effusion takes place. The patient may recover from either of these conditions; but, in the latter, paralytic symptoms will be apt to remain.

A third mode of poisoning is by the superinduction of *inflammation of the brain or its meninges.* This condition is either left behind after the disappearance of the coma, or the symptoms of the two conditions are commingled. Whenever, with more or less stupor, there are delirium, convulsions, tonic contraction of the flexor muscles, and local or partial palsy, the existence of the inflammatory complication may be considered as pretty certain. This condition of things, however, is more apt to accrue from a continued debauch of several days, or weeks, than from one hard drinking spell, unless there may have been a predisposition to the affection. It is a very dangerous condition, and many die of it; often sinking into a state resembling typhoid fever before death.

Still another mode of poisoning is by acute inflammation of the stomach and bowels. *Gastritis*, in a greater or less degree, I have frequently witnessed, in the Pennsylvania Hospital, among patients brought in while labouring under the effects of strong drink. But it is very seldom fatal. Instances, however, are on record, in which this seems to have been the immediate cause of death.

The accidental deaths resulting, in the coma of drunkenness, from exposure to cold, from drowning, or from various kinds of violence, as when the body is run over by a locomotive on railroads, do not properly fall into this category; though they are useful warnings, and may be appropriately enumerated in the list of evils consequent upon this terrible vice.

Chronic Poisoning. A great diversity of evils arise from the habitual use of alcoholic drinks. I shall treat of them in the order of their successive occurrence.

1. The stimulant influence of alcohol renders the system at all times more liable to inflammatory attacks from ordinary causes, especially in the earlier stages of its habitual use, or in those persons who employ it in such a manner as not materially to impair the energies of their system. It has this effect, first, by inducing a plethoric state of the blood, which predisposes to inflammation, and, secondly, by stimulating the circulation, and thereby acting as an exciting cause when a predisposition already exists, or aiding other irritant influences.

2. Conjointly with the use of rich food and stimulating condiments, it contributes to the development of gout. In persons predisposed to this disease from inheritance, it hastens its appearance; and, in those not predisposed, it is quite sufficient, in conjunction with the other agencies mentioned, to originate the diathesis. But, of those who abuse alcoholic liquors, only a comparatively small number are attacked with gout. This demands explanation. The origination of the gouty diathesis requires the co-operation of causes which, without materially impairing the vital forces, shall produce and sustain an habitual state of plethora and excitement. In great excess, alcoholic drinks rapidly wear out the excitability of the system, and induce an indirect debility, which leads to various other disorders, but is incompatible with the generation of the gouty constitution. More moderately used, however, and with rich food, they stimulate the blood-making functions, without so rapid an exhaustion of the excitability. A greater amount of food, therefore, is converted into blood than without the aid of the stimulant, and a state of plethora is produced, which the continuance of the same habit sustains. The abuse, consequently, of wines and malt liquors is more apt to cause gout than that of ardent spirits; and hence the prevalence of this dis-

ease among the rich and luxurious. But the amount of exercise taken has also much influence over the result of alcoholic stimulation. By vigorous exercise the plethora induced by wine-drinking and a rich diet is repressed, the excess of blood is consumed by the excess of the excited functions, and the equilibrium of health is preserved. Hence, a person of somewhat luxurious habits of eating and drinking may counteract their effects by proportionally vigorous exercise. It is from a conjunction of the moderately luxurious with sedentary habits that we are to look for the development of gout. Again, an excess in the use of alcohol which would soon indirectly wear out the powers of a sedentary man, if counterbalanced by violent bodily exertion, may tend to sustain the system at a point of elevation favourable to this disease. An individual may become intoxicated at his table every evening, and yet, if he spend all the morning in some active exercise, as on horseback in the chase, may ward off the prostrating influences of the poison, and escape with only the penalty of gout. It is not so much, therefore, the particular quality of the liquor drank, whether it be wine, or whether rum, which determines the occurrence of gout preferably to general debility, as it is the quantity of the stimulus used, and the other attendant circumstances.

3. Another evil arising from the abuse of alcohol is the direct production of inflammation in the organs upon which its stimulant agency is most strongly exerted. Sometimes this inflammation is acute; but much more frequently it is chronic, and the necessary result of a long-sustained irritation. The organs upon which alcohol especially expends its force are the stomach, the brain, and, secondarily, the lungs and the liver. These, therefore, are most frequently affected; but the bowels, kidneys, heart, and arteries sometimes participate in the disease. Evidence of this is exhibited not only by the symptoms during life, but by the appearances upon dissection. Every physician is familiar with the chronic gastritis of drunkards. Inflammation of the brain or its membranes is scarcely less common, though, in the acute state, often confounded with delirium tremens, and, in the chronic, masked by the disorder in the cerebral functions incident to habitual intoxication. Reference is often made, in the records of insane asylums, to intemperance as one of the causes of insanity. There are some persons who always have an attack of this disease, when they indulge in the use of alcoholic drinks. The duty is devolved upon the lungs, partly at least, to throw off, in the form of vapour, the portion of alcohol not expended in the nutritive process. Hence, bronchitis is a common disease of drunkards; and other pectoral inflammations are not unfrequent. The liver is another of the emunctories through which the superfluous alcohol is thrown off, probably in the form of fatty matter. This organ, therefore, is kept constantly in a state of undue excitation, and, as a re-

sult, is not unfrequently inflamed. Disease of the liver is among the most common complaints of habitual drunkards; and though, as will be seen directly, it is not exclusively inflammation that occurs, yet this does take place in a considerable proportion of cases. Out of seventy-three cases of drunkards examined after death by Dr. F. Ogston, of Aberdeen, Scotland, the liver was found generally hypertrophied in nine, and partially in two cases; and, though this hypertrophy may possibly have been in some instances the pure effect of a sustained over-excitement, yet much more probably there was in all an admixture at least of inflammation during life. It is not necessary to refer more particularly to the other organs mentioned. In all of them lesions are frequently found, which may be best explained by the supposition of the previous existence of chronic inflammation.

4. From the constant stimulation of the whole system, and especially of the brain, the excitability is so far exhausted that, on the withdrawal of the stimulus, a condition of extreme prostration takes place, which often ends fatally, unless counteracted. The brain, left without its habitual support, exhibits its suffering in a peculiar kind of delirium, called *delirium tremens* or *mania a potu*, the characteristics of which are singular hallucinations, the fear of some present or impending evil, sleeplessness, and muscular tremors. This has been considered by some as inflammation of the brain. But, in its pure form, it has nothing to do with inflammation. It is the simple result of the withdrawal of the alcoholic stimulus, and is a condition of real depression in the cerebral centres, showing itself by the irregularities referred to. It is, moreover, relieved by restoring the stimulant impression by means of alcoholic drinks or opium. In the Pennsylvania Hospital, I have had frequent opportunities of watching the attack and removal of this affection. I have, in numerous instances, seen it coming on more or less completely when the wonted stimulus has been withheld, and have almost as constantly seen it yield to a renewal of the stimulus. It will be observed that I am now speaking of pure delirium tremens. But there are often mixed cases of a very different character. In these, some inflammatory and febrile attack has rendered the patient careless of the stimulant, or averse to it. The cerebral centres, left unsupported, fall into the abnormal state under consideration, and there is now a mixture of local inflammation with delirium tremens. Not unfrequently the inflammation is the direct result of the alcoholic stimulus. The patient, goaded by his insatiable thirst for the poison, gives himself up for a period to the most frantic indulgence, until he is at length brought up by an attack of inflammation of the brain or the stomach, the direct result of the excessive quantity of alcohol taken. Then the debauch ends, and, the drink being suspended, delirium tremens along with the meningitis or gastritis seizes on its victim. These attacks, unless promptly and efficiently treated,

especially the meningeal cases, are very apt to terminate fatally, and sometimes do so even under judicious treatment; while the simple delirium tremens, which constitutes the vast majority of cases, is curable almost certainly, if the patient be prevented from sinking into a fatal prostration from the want of support.

But it is not only upon the withdrawal of the wonted stimulus that the effects of depressed function are experienced. With the constant repetition of the excitement, there is as constant a diminution of the excitability, so that the stimulated functions can be sustained only by a steady increase in the quantity of the stimulus, until the time at last comes when no quantity that can be taken is sufficient to support the working of the exhausted organs. It is surprising how much ardent spirit the system can be brought to bear. Two or three pints of raw spirit are consumed daily by some confirmed rum-drinkers. But, as just stated, even should no organic mischief happen in the mean time, the functions must at last fail. In relation to the stomach, dyspepsia; to the bowels, constipation; to the liver, insufficient secretion, are ordinary results. The circulatory and respiratory functions are also enfeebled; the generative function is impaired; and even nutrition, at first overstimulated, now fails, and the patient becomes either emaciated, or pale and bloated. The cerebral functions also suffer greatly. The intellect is enfeebled, the power of self-command is lost, and the predominant propensities or passions, whatever they may happen to be, are scarcely resisted. The influence of the will over the muscles is greatly impaired, and the patient is subject to habitual tremors when not under the fullest action of the stimulus. These tremors sometimes deepen into positive paralysis, though there is reason to think that, by this time, the brain has become organically deranged.

5. The last stage of physical degradation is now reached. The failure of the functions both organic and nervous leads inevitably to degenerate organization. The blood is depraved, nutrition suffers, and different parts of the frame undergo various degradation; those being most affected the functions of which have been previously most stimulated, and consequently most exhausted. In many instances, the vital forces have been so prostrated, in particular organs, that chemical influences predominate, and the tissue is converted more or less into oil. This is the fatty degeneration. In other instances, the disorganization is less complete; and abnormal tissues bearing some resemblance to the fibrous, cartilaginous, or bony, take the place of the healthy structure. The brain, the stomach, the liver, the kidneys, and the heart and blood-vessels are peculiarly the seats of this organic degradation; and their great vital functions suffer accordingly. The most diversified forms of functional or organic disease are presented in different cases, most of them tending to a dropsical condition, in which the patient is at last apt to perish, if he

has escaped the numerous dangers which have beset him almost from the beginning, and which cause vast numbers to be carried to a premature grave. The cirrhosed or fatty liver, the granulated kidney, the hypertrophied or dilated heart with its various valvular disease, the ossified blood-vessels, and the depraved blood, deficient in red corpuscles, but abounding in oil and carbon, are the most frequent causes of the dropsy.

Dr. Magnus Huss, Professor of Clinical Medicine in Stockholm, has described a paralytic affection, which he denominates *alcoholismus chronicus*, and which he ascribes solely to the poisonous influence of alcohol. It is very common in Sweden, where intemperance is said to prevail to a fearful extent. The affection shows itself first in tremors and unsteadiness of the voluntary muscles, usually commencing in the upper extremities, then extending to the lower, and at length involving the muscles of the trunk. The trembling is often violent, particularly on the occasion of any voluntary effort, and is greatest in the mornings before the patient has had recourse to his accustomed stimulus. Sensation after a time begins to be affected; formication occurs here and there; and at last both sensation and the power of motion are lost over a greater or less extent of the body, the special senses being not unfrequently involved. Instead of this paralytic condition, the poisoning may assume the spasmodic or convulsive character, marked at first by twitchings, and afterwards various irregular muscular contractions, terminating in positive epileptic paroxysms. All these phenomena are readily explicable. The first failure of muscular power is probably the result of mere exhausted function in the brain; but the more serious subsequent results must be ascribed to the organic changes which have, in the mean time, been going on in the cerebral tissue.

6. Another and not the least evil of the abuse of alcoholic liquors, is the increased danger given by it to other diseases; partly through the impaired state of the constitution, which renders it less able to resist them; partly through the impossibility, under which it places the physician, of using that energy in the treatment which the diseases may require; and, in some degree also, in consequence of the relative inertness of alcoholic remedies in the intemperate, in whom they are most needed.

I have purposely avoided the consideration of the moral aspect of intemperance, which, even if we confine our views to this world, presents an amount of evil, far exceeding the physical, terrible as this must be acknowledged to be.

Appearances on Dissection. When death has occurred suddenly from enormous quantities of the poison, no pathological appearance need be expected after death; the stomach and brain being at once overwhelmed by the violence of the shock. In the more protracted cases of acute poisoning, the signs of inflammatory congestion of the stomach are sometimes, though not always presented; but there is usually congestion of the brain, with occasional effusion into the ventricles, which has the odour of alcohol, and in one instance is said to have been inflammable. Congestion of the lungs is also an occasional result of acute alcoholic poisoning; and, in the case of a child recorded by Dr. John Ashhurst, appeared to be the cause of death, through the copious effusion into the air-passages. (*Am. Journ. of Med. Sci.*, July, 1863, p. 128.)

In cases of habitual drunkards, dying either directly from the effects of the poison, from suicide, or other forms of violent death, and from accidental diseases, there is almost always some lesion discoverable, which may be fairly ascribed to the poison; sometimes the direct consequence of constant irritation, as hypertrophy; sometimes of pure deficiency of action, as atrophy; very frequently of inflammation, and still more frequently of various degeneration.

Out of 117 cases examined by Dr. Ogston, only one was without some discoverable lesion.* The lesions were most numerous in the brain and its appendages, and after this, successively, in the respiratory organs, the liver, the circulatory organs, the kidneys, and the alimentary canal. That the smallest number should have been found in the stomach and bowels is not what might have been anticipated; but the probability is that more of the lesions in this structure were to be ascribed to the alcohol exclusively than in the others, unless the brain be excepted. It will of course be understood that many of the morbid appearances would have been found in temperate persons; but assuredly in greatly less proportion. In the *brain* the most frequent changes were thickening of the arachnoid, effused serum, injection of the pia mater, and induration or softening of the cerebral substance; in the ***respiratory organs***, pleural adhesion and partial emphysema; in the ***heart and its appendages***, hypertrophy and dilatation, obesity, valvular disease, pericardial adhesion or thickening, and atheromatous or osseous deposition or degeneration in the large vessels; in the *stomach*, extraordinary diminution of size or atrophy, congestion, softening of the mucous membrane, and hypertrophy or thickening of the walls, which, however, was seen in three only out of the whole number of cases; in the *liver*, fatty degeneration, hypertrophy, cirrhosis, and the nutmeg appearance; in the *kidneys*, hypertrophy, congestion, and fatty degeneration. (*Brit. and For. Med.-chir. Rev.*, April and October, 1854.)

---

* Of the different organs, the brain and its appendages were affected in 108 of the cases, or 92.3 per cent.; the respiratory organs in 74, or 63.24 per cent.; the liver in 66, or 56.4 per cent.; the heart and its appendages, including the aorta and pulmonary artery, in 56, or 47.86 per cent.; the kidneys in 51, or 43.58 per cent.; and the intestinal tube in 48, or 41 per cent. (*Brit. and For. Med.-chirurg. Rev.*, July, 1855, Am. ed., p. 145.)

Treatment of Alcoholic Poisoning. In the acute cases, the prominent indication, in the earlier stage, is to evacuate the stomach; for which purpose recourse may be had to emetics or the stomach-pump. The latter is the most effectual method, though, in the absence of the necessary implements, the former should not be neglected. At the same time, cold water should be freely and steadily applied to the head, and sinapisms or other rubefacients, or hot pediluvia to the lower extremities. Pouring cold water into the ear has been recommended, in order to rouse the patient from stupor; and, with the same view, in its first application, it may be poured from a height on the head or shoulders. Bleeding, either general or local, or both, should be used when the pulse is full and strong, and organic mischief in the brain is apprehended. Should respiration be suspended or nearly so, it should be supported artificially, until nature may be able to maintain the function, or undoubted death shall have taken place. In the stage of prostration, after the direct action of the stimulant has ceased, and nothing remains but the depression consequent on the previous excitement, the system should be supported by external and internal stimulation. When the patient cannot swallow, the stimulant should be injected into the stomach or rectum. Carbonate of ammonia, or aromatic spirit of ammonia may be used, so far diluted as not to injure the mucous membrane; and even brandy may be resorted to, especially in the form of milk-punch by the stomach. It is not now the presence of the alcohol that is endangering life. It is the prostration; and that may be very properly counteracted by a smaller amount of the stimulus, so as to cause the system to subside gradually from its previous state of exaltation. This treatment, however, should not be employed until the skin becomes cool, the pulse feeble, and the danger from prostration obvious.

In chronic poisoning, the only remedy is abstinence. It is rarely that the affection has proceeded so far, that a cure may not be effected, or the state of the system very much ameliorated, by this measure. Unless some essentially fatal disorganization has taken place, as in cirrhosis of the liver, the system may be gradually led back to health by a reversal of the process which has brought it into the diseased state. A sudden withdrawal of the stimulus, without the substitution of something of a similar character, is dangerous. Death frequently results from this cause. Delirium tremens is an almost constant consequence, when the habitual excess has been great and long continued. The chief difficulty lies in the want of co-operation upon the part of the patient. The same infirmity of will that led to the evil, is in the way of its removal. I have often, however, had patients under my care in the Pennsylvania Hospital, who have been willing to submit to the requisite restraints, and invariably they have been dismissed without evil consequences, and cured for the present of the evil habit. The simple measure is to allow them at first somewhat less than their ordinary amount of stimulus, preferring the milder kinds when they will answer, as wines and the malt liquors, and daily to diminish the quantity, always endeavouring to sustain them above the point of sleeplessness or delirium. Opium often comes in very happily as an adjuvant, to obviate nervous disorder and produce sleep; but this also must be withheld, as the system is found capable of doing without it. Sometimes there is an advantage in partially substituting for the pure stimulus one of the bitter tinctures, especially that of hops; and recourse may be had to the nervous stimulants, as assafetida, valerian, and Hoffmann's anodyne, when nervous irregularities may seem to call for them. When the health has been materially impaired by the long continuance of the habit, it is necessary, as the original stimulus is withdrawn, to address remedies to the system in order to correct the diseased functions, or repair the diseased organs; such as the bitter tonics and aromatics for dyspepsia, rhubarb and aloes for constipation, the chalybeates to improve the blood, and nitromuriatic acid or the blue pill to obviate hepatic disease.

When the patient cannot or will not summon resolution enough for a steady perseverance in the above plan, it is better for him to break off at once, and take the risk of the evil consequences, than to incur certain destruction from continuance in the vicious habit. Under proper medical superintendence, even should delirium occur, the case may almost always be conducted to a safe issue.

Of the management of delirium tremens I do not propose to treat in this place, as I have already fully considered the subject in my work on the Practice of Medicine. I would simply observe that, on the whole, I prefer the opiate plan of treatment moderately conducted, giving only so much alcoholic drink as may be sufficient to obviate prostration, and gradually withdrawing both.

There is one important practical point, however, to which I would especially invite the attention of the student. He is not to consider cases of meningeal inflammation or acute gastritis, when brought on by intemperance, and then mingled with delirium tremens, as instances purely of the latter disease. In these cases, he must deplete for the inflammation, while he supports the actions of the nervous centres by alcoholic stimulation, which, in drunkards, when given in less than the habitual amount, acts as a real sedative. The same rule holds in regard to inflammatory affections, which may come on accidentally in the intemperate, and, in consequence of the suspended use of the stimulant, become complicated with their peculiar delirium.

Dr. Marcet, of London, recommends the use of oxide of zinc in chronic alcoholic poisoning, beginning with two grains, twice daily, an hour after meals, and increasing by two grains every three days, until the last dose amounts to six or eight grains. (*London Lancet*, April, 1859, p. 346.)

2. *Mode of Operating.*

The operation of alcohol as a stimulant is probably dynamic, that is, the result of its influence on the vital properties of the tissues, and independent of any chemical action exerted upon those tissues. At least, we have as yet no proof of chemical change produced in the organs which it stimulates; and all theories based upon such a change are, in the present state of our knowledge, conjectural. It is true that, in its more concentrated form, its affinity for water, and its disposition to coagulate albumen, may cause disorganization of the tissues, as any other chemical escharotic may do; but this is not its ordinary medicinal operation, to procure which it is always given much diluted. The theory that the excitement it occasions is a vital reaction against its chemical affinities, is, therefore, gratuitous. It may possibly be true; but we have no proof of it; and the safest conclusion is that, like any other stimulant, it produces its characteristic effects simply through its relation to the vital properties, which determines that, when it is brought into contact with the living tissues, these should take on an increase of action.

Its first effects on the brain may possibly result, in part at least, from the sympathy of that organ with the stomach. Indeed, so close is this relation, that any strong impression in one is very apt to make itself sensible in the other. The fact stated by Orfila, that alcoholic liquors act with less energy when injected into the cellular tissue than when taken into the stomach, seems to favour this view. But, whether the cerebral effects have or have not their commencement in sympathy with the gastric impression, they are chiefly attributable, throughout their course, to the direct action of the alcohol circulating through the brain. That this principle is absorbed, when liquids containing it are swallowed, is beyond all doubt. Its rapid disappearance from the stomach, and its odour in the breath are sufficient proofs of the fact. But it has been found also in the urine, bile, liquors of the serous cavities, brain, liver, and the blood itself; and especially abundant in the brain, in the ventricles of which it is asserted sometimes to have existed in an inflammable state. Dr. Ogston in one instance "found about four ounces of fluid in the ventricles, having all the physical qualities of alcohol" (Pereira's *Mat. Med.*, 3d ed., p. 1987); and, in another instance, while heating over a candle, three or four drachms of urine taken from the bladder of a man who was drowned while intoxicated, he observed that its vapour was set on fire by the flame. (*Brit. and For. Med.-chir. Rev.*, July, 1855, Am. ed., p. 148.) Coming then into direct contact with the nervous centres, the alcohol stimulates them into excessive action, and thus gives rise to the phenomena of excitement which characterize the early stage of its operation. Every excitation of a part is attended with an increased flow of blood into it, and the active congestion increases with the excitation.

By the continued operation of the alcohol, the congestion is continually increased in the cerebral centres, which, after their brief exhilaration, become disturbed, and at length embarrassed or overwhelmed, all through the direct and continued irritation of the same agent. Hence the intoxication and ultimate stupor which follow the primary excitement. But at length, the alcohol ceasing to act, the cerebral centres become depressed in proportion to their previous elevation; and general prostration of the system results. The wearing out of the excitability, the ultimate general debility, and the consequent degradation of the organs, resulting from long-continued intemperance, have been sufficiently noticed.

The influence of alcohol upon the brain has been ascribed to the altered and more highly carbonized state of the blood. Of this there is no proof whatever; nor, except in the single fact of stupor, is there any resemblance between the effects of this substance and the condition of the blood referred to. From the experiments of Dr. Böcker, it would seem that alcohol diminishes the amount of the solid and fluid excretions by the urine, and the quantity of carbonic acid exhaled in respiration, without increasing the fecal discharges, the perspiration, or the loss of water by the lungs.* Hence it has been inferred that it lessens the rapidity of the normal disintegration of the solids, and consequently diminishes the general activity of the functions; for the measure of their activity is the quantity of effete matter thrown out of the system. Hence, too, the practical inference, that it enables the body to be sustained by a less amount of food. But these are conclusions much too large for the basis on which they rest. We need many more, and much more variously repeated experiments, before they can be justified. No facts of observation seem more obvious than that alcohol stimulates the functions of the stomach and brain to increased activity; that it for a time invigorates digestion, promotes nutrition, increases the action of the kidneys or the skin, according as it is directed to one or to the other, and elevates the intellectual and emotional functions. How it can effect all these ends, without a more rapid disintegration and renewal of the structure, is inconceivable to one who considers such disintegration as a necessary attendant of every vital action. That, when taken in excess, it will overwhelm and, in some measure, paralyze the functions after the first excitement is past, and that, in this way, it may on the whole diminish the amount of the excretions; and that by the wearing influence of its long-continued abuse, the functions come at last to be in great measure prostrated, is readily intelligible. But that, during its stimulant operation, it should not promote a more rapid change of the tissues which it stimulates, is quite incompatible with the present views of the connection between the actions and the wear and tear of the system.

---

* The experiments of Dr. Böcker have been confirmed by those of Dr. Hammond, of the U. S. Army. (See *Am. Journ. of Med. Sci.*, xxxii. 313.) It may be admitted that, in the long run, alcohol diminishes the metamorphosis of the tissues, as it does all the vital functions, through the diminution of excitability and the production of debility; but I cannot admit that this result takes place during its stimulant action; and, if the amount of excretion of all kinds be diminished, during its direct action, I should, as before stated, be disposed to ascribe the result to a more thorough appropriation and assimilation of the food, which prevent the useless portion of it that may reach the blood, from passing off in the shape of urea, the phosphates, sulphates, etc. (*Note to the second edition.*)

But it is an undoubted fact that the habitual use of alcohol lessens the desire and apparent necessity for food; and it seems to be well proved, that a labourer can do a certain amount of work with less ordinary aliment, if freely supplied with beer or wine, than when water alone is allowed for drink. But this fact is explained, at least in the early stage of the action of alcohol, not by the diminished integral change in the tissues, but by the double fact, that it promotes the more perfect digestion of the food taken, and at the same time supplies food itself. If the usual amount of food is swallowed, alcohol favours its digestion and conversion into blood, and hence produces a plethoric state. This reacts on the stomach, diminishing the desire for food; and hence less is taken. But, as stated, alcohol is itself in all probability assimilated. What else becomes of it? Assuredly, but a very small portion of that taken into the body leaves it unchanged. It is certainly decomposed in the system. If, as some suppose, it were merely oxidized into water and carbonic acid, there would be a vast increase of the excretions of these products by the lungs, which, from the experiments of Dr. Böcker and some others, would seem not to be the case. It is probably converted into some one or more of the proximate constituents of the body; and I am among those who believe that it may, through the agency of the vital forces, and in the presence of organized nitrogenous matter, be converted into any one or all of those constituents, excepting only the mineral. The one, however, which most obviously results, is oil; and this is often generated with great rapidity. It is not only visible in the increase of the adipose tissue, and in the promotion of obesity in certain individuals, but it exists also in abnormal proportion in the blood; and the oleaginous change is probably the first step of the conversion of alcohol into materials fit for organization. And why should not alcohol be capable of digestion? It is generally admitted that many of the organic acids are so, as vinegar, citric acid, etc. Now, by a very easy change, alcohol itself is convertible into acetic acid. The inference seems to me inevitable, that it also is capable of being digested and assimilated. It is food, therefore, as well as a stimulant; and this view certainly best explains the plethoric condition, and increased weight and fulness of the body, often so strikingly observable under its use, while the amount of other kinds of food taken is diminished. But this fact in no degree justifies its abuse. The various evils to which its excess gives rise are neither lessened in themselves, nor do they constitute a less unanswerable argument against the abuse of alcohol, from the fact that it may contribute to the nourishment of the body. In opposing an enemy, it is useless if not dangerous to shut our eyes against his good qualities, and bad policy to put ourselves into a position in which we cannot avail ourselves of them.

3. *Therapeutic Application.*

The first great question in the therapeutics of alcohol is how far its habitual use is favourable or unfavourable to health. In the greater number of cases, judging from the experience of the world since the beginning of history, it is of little consequence to the health of the individual, whether he drink it or not, provided he do not exceed the limits of temperance, and especially if he confine himself to the pure fermented liquors. But there are two classes of individuals to whom this remark does not apply. In *one of these classes*, the possession of a peculiarly sanguine or nervous temperament, renders them strongly susceptible to injury from substances calculated, in the one instance, to favour the overproduction of blood, and, in the other, to stimulate the unduly excitable nervous centres. In these persons, the habitual use of alcoholic drinks, which have in a high degree both the properties mentioned, is hazardous to health, and should, therefore, be avoided. It endangers inflammation, hemorrhage, and serious cerebral disease. In the *second of the classes referred to*, the contrary of this proposition is true. Nature, while planting in so large a proportion of the human family a disposition to scrofulous or tuberculous complaints, seems to have provided, in the fermented liquors, what, if properly used, may be considered as in some degree a counteracting agent. Physicians have often noticed that drunkards seldom die of phthisis. In this respect, my own observation coincides with that of others. During my tours of hospital duty in the winter, I have met with great numbers, both of drunkards and of tuberculous individuals; but it is very seldom that I have seen the two classes coincide. This is a singular fact, and not exactly what might have been anticipated; for the tuberculous constitution belongs to the same cachectic category with that which gives a tendency to fatty degeneration, cirrhosis of the liver, granular disease of the kidney, etc., and is not unfrequently associated with it. *A priori*, it would have been imagined that the exhausted state of general health, characterizing the advanced stages of intemperance, would favour tuberculous deposition; and the discovery of the opposite truth has been something like a surprise to the profession. This result of observation has been singularly confirmed by recent pathologico-anatomical investigations. Out of 117 cases of confirmed drunkards, whose bodies were examined after death by Dr. Ogston, there were only two who exhibited any evidence of tuberculous disease of the lungs. In one of these there were some latent tubercles, and in the other a single tuberculous cavity in the right lung; and in neither was this affection the cause of death. (*Brit. and For. Med.-chir. Rev.*, April and October, 1854.) In the same number of temperate persons, of different sexes and ages, examined after death from other causes, the same result would assuredly not have been obtained.* How alcoholism acts adversely to the development of tubercle may be conjectured, but is not certainly known. In its earlier stages, it may be supposed to sustain a grade of elevation in the vital functions, and richness of the blood, above that at which there is a tendency to the deposition of tuberculous matter. But this is certainly not the case in the latter stages, during which, so long as the stimulus continues to be used, there appears to be the same exemption. Perhaps, as many suppose, it is the more highly carbonated state of the blood in the inebriate that protects him against tuberculosis. Possibly, the large proportion of oil contained in it may have some preservative tendency, similar to that exercised by cod-liver oil. It would be a perverse reason that would deduce from the fact here stated an argument in favour of intemperance. Assuredly, of the two, even admitting that the security afforded is complete, which it is very far from being, death from pulmonary consumption is infinitely preferable to death from drunkenness, or even to the life of a drunkard. But a just inference is, that they who may be predisposed to phthisis or scrofula, or may be labouring under the disease, may, with propriety, and probably with advantage, employ the fermented liquors habitually, though always in moderation. By adhering to the rule, never, under any circumstances of ordinary health, to use any one of the forms of ardent spirit, but to adhere exclusively to the fermented liquors, they may avoid the danger of intemperance, and yet obtain all the immunity which alcohol can confer.

In giving the above general rules in relation to the habitual use of alcoholic liquors, it will be perceived that I confine myself wholly to the medical aspect of the question. How far an individual may feel himself bound to forego a harmless gratification, or to sacrifice, in some instances, a positive good, for the sake of an example to others of weaker will, or of a constitution more susceptible to injury from alcoholic drinks than himself, is a moral question upon which there is no occasion to express an opinion in this place. One point, however, I would urge, with whatever weight of authority a life of observation may have given me, and with all the strength of expression I possess, that, whenever an individual discovers in himself the least tendency to excess in these drinks, or the least deficiency of power to restrain himself within due limits when slightly under their influence, he should promptly abandon them altogether, and permit no sophistry of inclination to overcome his resolution of entire abstinence for the future.

---

* See an elaborate paper, by Dr. John Bell, of N. York, on the effects of alcoholic drinks in tuberculous disease, in the *Am. Journ. of Med. Sci.*, Oct. 1859, p. 407, in which much evidence has been collected upon the subject referred to. The tendency of this evidence appears to me decidedly to confirm the views given in the text. (*Note to the second edition.*)

In *low febrile diseases* the alcoholic liquors are a most valuable resource, and, indeed, often indispensable. At least, I have very frequently met with conditions in these fevers, in which I should have quite despaired of a cure without their aid. They are not so well adapted to the prostration or collapse which sometimes occurs in the cold stage, at the commencement of the fever, as to the debility coming on in its course. The continuance of their stimulant influence into the stage of reaction, and their special tendency to the head, might possibly, under the former circumstances, injuriously increase the fever and cerebral disturbance; and they should, therefore, be employed only when the arterial stimulants may prove inadequate to the end in view. But to the latter condition, the debility, namely, which so often supervenes in febrile diseases, and not unfrequently constitutes their greatest danger, they are adapted, beyond all other medicines, by the universality as well as energy of their stimulant property. Operating specially upon the brain, they rouse it from the torpor by which it is apt to be overwhelmed in the advanced stage of fevers of the typhoid character, and prove much more efficient in sustaining life than the arterial or nervous stimulants. They are indicated when the pulse is feeble, and the skin cool, and particularly when, with these evidences of debility, are associated the dark tongue, the sordes about the teeth, and the stupor or low delirium of the typhous state, indicating a depraved condition of the blood. Even when the skin is hot, if the other symptoms appear to call for their use, they should be tried. I believe they not only stimulate in these cases, but prove useful also by directly contributing, through their nutritive properties, to the improvement of the blood. Unless the prostration is sudden and alarming, the mildest form of these stimulants should be first employed, and recourse be had to the stronger only as the increasing debility may seem to require them. Thus, it is usually advisable to begin with wine-whey, then, if necessary, to advance to pure wine, and ultimately to ardent spirit. Should the skin become hotter and dryer, the pulse more frequent, and the patient more restless and delirious under the stimulant, it should be diminished or discontinued; but, should the contrary condition occur, should the skin become soft or moist, the pulse slower, fuller, and stronger, and the patient more comfortable and less disposed to delirium, it may be taken for granted that the remedy is operating favourably, and should be continued. It is in *typhus, enteric or typhoid, and petechial* *fevers*, that the alcoholic remedies generally prove most useful; but most other febrile affections sometimes assume the same low character, and require the same treatment. The alcoholic liquids may often be advantageously used in *scarlatina*, *diphtheria*, *smallpox*, and *erysipelatous fever*, and occasionally in *bilious remittent* and *yellow fevers*, when they present typhoid symptoms. Even the existence of inflammation, under these circumstances, does not positively contraindicate them. Active alcoholic stimulation is often necessary in typhoid or typhous pneumonia.

In the *advanced stage of inflammation*, when copious *suppuration* has taken place, and the patient is sinking under it, the alcoholic stimulants are often called for, to aid in supporting the strength until the exhausting influences shall have ceased, or, when the case is hopeless, to render the patient more comfortable, and protract his life. Such a condition is presented in the *suppurative stage of pneumonia*, *abscess of the lungs* and *kidneys*, *purulent phlebitis*, *lumbar* and *psoas abscess*, *suppuration of the large joints*, *extensive caries of the bones*, and *very large* or *numerous ulcers upon the surface*. To this category may be added various constitutional affections attended with suppurative or ulcerative conditions, as *erysipelas affecting the cellular tissue*, *confluent smallpox after the maturation of the pustules*, all *scrofulous affections* including phthisis, *syphilis in the ulcerative stage*, and several of the *cutaneous affections*, particularly *rupia* and *ecthyma*.

Precisely the same indication is offered by *gangrene*, whether resulting from inflammation, from purely depressing agencies, or from a vitiated state of the blood. The system requires support against the directly depressing influence of the gangrene, and of the processes requisite for the separation of the slough, and also to enable it to repair the injury done. It is unnecessary to enumerate all the affections in which this condition may occur. In severe internal inflammations, there is occasionally an abrupt cessation of the pain, with symptoms of great prostration, which have been supposed to indicate the occurrence of mortification, and often perhaps truly, even though certain evidence may not be exhibited by putrefaction after death. *Strangulation of the bowels*, whether concealed as in invagination, or obvious, as in hernia, very often ends in mortification. Other examples of this affection we have in *gangrene of the lungs* and *of the mouth*, that which attends *malignant erysipelas*, *carbuncle*, and the *malignant pustule*, and lastly that arising from *severe burns*, *injuries of the blood-vessels*, *arteritis*, *the poison of ergot*, etc.

In the above suppurative and gangrenous affections, and all others of a similar character, alcoholic stimulation is very frequently indicated, and sometimes strongly so. But it must be remembered that they are usually attended with more or less remaining inflammatory or systemic excitement, which requires caution in the use of the stimulant; and, as a general rule, the fermented liquors will be preferable to the spirituous. Most frequently, in these conditions, there is also an indication for the use of opium and sulphate of quinia or other preparation of Peruvian bark.

There is a state of system, essentially one of debility, in which the blood is poisoned by noxious matter absorbed into it, and which does not come exactly into either of the preceding divisions. To this belongs the condition denominated *purulent infection, metastatic abscess*, and *pyogenic fever*. It is a condition in which, probably, disintegrated pus, or other sanious secretion from vitiated sores, is absorbed into the blood, and depraves its character. Analogous to it is the state of system arising from *dissecting wounds*. Alcoholic stimulation is often indicated in this condition.

Considerable attention has recently been attracted to the asserted efficacy of this remedy in the state of system resulting from the *bites of poisonous serpents;* and cases have been recorded which go far to prove that it really possesses no inconsiderable curative powers.* The prostration of system which attends the operation of the poison would appear to indicate stimulation; and the ammoniacal preparations have long been in repute as antidotes. To produce the desired effect, the alcoholic remedy, it is said, must be given very freely; and, in most of the cases, it has been pushed to intoxication. It seems, however, that the system, when strongly under the influence of the poison, resists its influence, as tetanus is known to do. In a case recorded by Dr. T. A. Atchinson in the *Southern Journal of the Medical and Physical Sciences* for March, 1853 (vol. i. p. 108), in which the patient, a young woman of seventeen, was found almost moribund two hours and a half after the bite of a rattlesnake, three pints of whisky, given in doses of a glassful every hour, though it produced reaction, and apparently saved the life of the patient, occasioned not the slightest intoxication. During the same time, however, eighty grains of carbonate of ammonia were given, which has been supposed to have some power of obviating the inebriating effects of alcohol. A young medical friend of mine informed me that, while upon an excursion in Texas, he was bitten by a poisonous serpent, and had already begun to experience alarming local as well as constitutional effects, when the progress of the poisoning seemed to be arrested by ardent spirit, given until it rendered him insensible. So many instances occur, in which spontaneous cures of snake-bites take place after the exhibition of threatening symptoms, and so many others in which the effects of the bite are simply those of a shock produced by fright upon the nervous system, that it is very difficult to determine how much value can be attached to any remedy, which may be recommended on the ground of experience. In the *St. Louis Medical and Surgical Journ.* (xii. 26) is a communication from Dr. J. Gilman, in which, as the result of numerous experiments directly with the poison of different serpents upon plants and animals, he found that alcohol, "if brought in contact with the venom, is, to a certain extent, an antidote;" while the poison mixed with the solution of ammonia and various other agents "seemed to act with undiminished energy."

---

* For accounts of cases, see a paper read by Dr. Edward Hallowell, before the College of Physicians of Philadephia, Dec. 1, 1852, in the *Transactions of the College*, N. S., i. 394; the *New Jersey Medical Reporter* for March, 1853 (vol. vi. p. 195), in which a case is recorded credited to the *Southern Medical and Surgical Journal;* the *Southern Journal of the Medical and Physical Sciences* for March, 1853 (vol. i. p. 108); and the *Boston Medical and Surg. Journ.* for January, 1854 (vol. xlix. p. 506).

In some *nervous diseases*, alcohol possesses considerable powers. In *tetanus* it has been given very freely, in the form of wine and ardent spirit, and is among the remedies upon which most reliance has been placed. The most suitable time for giving it is at the first appearance of the characteristic symptoms, and before the disease has become fully established; and it should be so exhibited as to give obvious proofs of affecting the system. It has been much used also as a preventive, when serious apprehensions have been entertained of an attack. The disease, when fully formed, resists the influence of alcohol strongly; and it is very difficult to obtain its characteristic effects. In the *trembling palsy*, alcoholic stimulation is sometimes temporarily beneficial; and it may be used with great advantage in those cases of *delirium from exhaustion* which imitate *delirium tremens*. Of its employment in the latter affection enough has been said already.

Finally, alcoholic liquors may be used in the *debility arising from excessive secretion or hemorrhage*, in *that of convalescence*, and in that which attends the *advanced stages of most incurable diseases* before the fatal issue. In *epidemic cholera*, it is highly recommended, in large doses, by M. Gaillard, who has found great advantage from it in that affection, which, according to his statement, is characterized by a strong insusceptibility to its intoxicating effects. Of the different forms of alcoholic liquor he prefers rum, of which a bottle or more may be given in the day. This quantity was borne by a delicate woman, wholly unaccustomed to alcoholic stimulation, without the least sign of intoxication. (*Ann. de Thérap.*, A.D. 1865, p. 127.) In the *acute diseases of intemperate persons*, it is generally necessary to have recourse to these liquors, in order to sustain life, even when there might be otherwise no indication, or a positive contraindication; care being taken to give them in as small a quantity as the circumstances of the case will admit, while efficient methods are employed to combat the disease, such as would be used in cases without this complication.

In the use of these drinks, a preference should always be given to the weaker, whenever sufficient to answer the intended purpose; and, from the weakest up to the strongest, there should be a graduation directly in proportion to the debility, and at the same time the insusceptibility of the system.

Alcohol has lately been employed as a dressing for wounds by several French surgeons, imitating a practice as old as the times of Hippocrates, who recommended wine for this purpose. In favour of the plan, it is asserted to promote union by the first intention, and to prevent various unpleasant accidents which are apt to follow, especially in hospitals, such as purulent infection, hospital gangrene, angioleucitis, and erysipelas. Alcohol is sometimes used in its purer forms, of the sp. gr. 0.835 for example, as in gangrenous wounds; sometimes in the form of ardent spirit, as brandy, whisky, camphorated spirit of 0.923 sp. gr., tincture of aloes, etc. It is applied on compresses, steeped in the spirit, care being taken always to keep the wounded part sufficiently moist. (*Arch. Gén.*, Dec. 1864, p. 725.)

Another local use of alcohol, suggested by Dr. Luton, of Rheims, is by means of subcutaneous injection, for the relief of obstinate neuralgia. Twenty drops may be thrown into the areolar tissue, as near the affected nerve as possible. The operation is attended by a rather severe pain, followed by swelling; but this soon subsides. (*Ibid.*, Oct. 1863, p. 285.)

Contraindications. In chronic debility, the alcoholic liquors should be employed with great reserve, from the fear of originating habits of intemperance. They are contraindicated in plethora, in fever and acute inflammation with a sthenic state of system, in acute gastric and cerebral inflammations under almost any circumstances except in drunkards, and in cases of special sanguineous determination to the brain.

4. *Forms in which Alcohol is used.*

a. *Fermented Liquors.*

1. WINES.—VINA.

The U. S. Pharmacopœia recognizes only two kinds of wine; 1. *Sherry Wine*, VINUM XERICUM, *U. S.* (VINUM ALBUM, *U. S.* 1850, *White Wine*); and 2. *Port Wine*, VINUM PORTENSE, *U. S.* (VINUM RUBRUM, *U. S.* 1850, *Red Wine*).

The wines used in medicine are exclusively the fermented juice of the grape. The same name has been given to the fermented juice of various other fruits, as the *currant, gooseberry, elderberry*, etc.; but these are not admitted into the Materia Medica, and should never be employed medicinally in the place of genuine wine, when the latter can be obtained.

Wines have been differently classified, according to their qualities and origin. The most important distinction for the physician is into the *light* and the *strong wines;* the former including those which consist exclusively or nearly so of the fermented grape-juice; the latter, those to which brandy or other form of ardent spirit has been added, to increase their body, and enable them to keep better. Among the former are *sauterne, claret, champagne,* the *Rhine* and *Moselle wines,* and *burgundy;* among the latter, *madeira, teneriffe, sherry,* and *port.* It will be noticed that the distinction between the two kinds is not only the difference in the quantity of alcohol they contain, but also in the circumstance that, in the one, this ingredient is in the state in which it was produced by the act of fermentation, in the other, is partly superadded, after having undergone the process of distillation.

Another distinction is into the *white* and *red wines,* the former being prepared from colourless grapes, or the juice of the red, without the skins; the latter, from the red, with their skins remaining. The only important difference between them, medically considered, is that the red contain tannic acid, which gives them astringent properties, and the white little or none. Of the wines above mentioned, sauterne, champagne, the hock or Rhine wines, and the Moselle wines, of the lighter varieties, and madeira, teneriffe, and sherry, of the stronger, generally rank among the white; and claret and burgundy, of the light, and port, of the stronger, among the red.

Another distinction is into the still and sparkling, the latter being characterized by the property of effervescence, depending on the presence of carbonic acid. This excess is owing to the circumstance that they have been bottled before the entire completion of the fermentation, so that the carbonic acid subsequently generated is confined. Any wine may be made sparkling in this way; but, generally speaking, it is only the *champagne* and *sparkling moselle* that have this quality. An excellent sparkling wine is made at Cincinnati, Ohio, from the juice of the Catawba grape; and I have seen a fine variety, little inferior to French champagne, produced in a vineyard of California, two hundred miles south of St. Francisco.

Some wines are acidulous, others sweet, and others, again, have scarcely any perceptible sourness or sweetness to the taste, though almost all contain acid, and most of them more or less grape sugar. The light wines are generally the most acid.

Composition. Besides alcohol and water, wines in general contain small proportions of *bitartrate of potassa, malic, tartaric,* and *carbonic acids, extractive, mucilaginous* and *colouring matters, œnanthic ether,* and a *volatile odorous principle;* and many of them, *grape sugar* and *tannic acid.* The proportion of *absolute alcohol* contained in them varies, according to Christison, from 6 to 17 per cent. by weight. The table of Brande gives proportions varying from about 10 to 26 per cent.; but it is alcohol of the sp. gr. 0.825, containing a considerable proportion of water, that is here referred to, and the ratio is by measure instead of weight; so that his numbers are necessarily higher. It is probable that the former statement approaches the truth most nearly. It is a point worthy of special notice, that the wines above mentioned as belonging to the lighter class contain, on an average, about half as much alcohol as those belonging to the stronger; and this remark holds true of the several varieties of the two classes. This fact is important in regulating the dose of the wines.

Bitartrate of potassa is most abundant in new wines, and is gradually deposited as they become older. Of the free acids, the *malic* is said to be most common, the *tartaric* being generally combined. *Carbonic acid* is probably in some degree present in all; but is most abundant, of course, in the sparkling. *Acetic acid* is sometimes present, but always probably as a product of the acetous fermentation of the alcohol, and therefore to be regarded as an impurity.

The odorous matter upon which each wine depends for its characteristic aroma is probably a *volatile oil* peculiar to each; but it has not been separated. There is in most if not all wines a volatile oily matter, in extremely minute proportion, which serves to impart to wines, as a class, their peculiar flavour, and quite distinct from the characteristic aromatic principles of the several wines. This is the *œnanthic ether*, discovered by Liebig and Pelouze, and is said not to exceed one in forty thousand parts. It has been obtained separate, and has been found, in this state, to have a disagreeable, very strong, intoxicating odour, and an unpleasant taste. It has been supposed that it might contribute to the intoxicating effects of the wines; but the point has not been determined.

Sugar is not a desirable ingredient in medicinal wines, and the sweeter varieties are therefore little employed.

Tannic acid is present in the red wines, and tends to render them astringent; but its effect in this way is, in some of the lighter wines, more than counteracted by the bitartrate of potassa, and other saline matter, and by the free acids they contain. Both this principle and the colouring matter is gradually deposited with time; and port wine, so strongly astringent when fresh, becomes after many years almost as colourless and free from astringency as madeira.

By long keeping, wine becomes softer to the taste, in consequence of the deposition of the bitartrate of potassa, to which they mainly owe their tartness, and of the tannic acid and colouring matter, when contained in them. When kept in casks, they gradually lose alcohol; but, according to a not uncommon opinion, their intoxicating property is rather increased than diminished; a result which, if true, may possibly be ascribed to the production of œnanthic ether.

Effects on the System. The effects of wine, as a mere alcoholic liquor, have been already sufficiently described; but there are certain peculiarities in its operation which demand notice. These result either from other ingredients, or from the peculiar state in which alcohol exists in the fermented liquors. Probably both these causes have some influence. It was at one time supposed that alcohol might not pre-exist in the fermented liquors, but result from the distillatory process. This, however, has been fully disproved; as Brande obtained it from wines without distilling them. There can, however, be little doubt that its influence on the system is modified by the state of association in which it exists in the fermented liquors. Wine is much less intoxicating, in proportion to the alcohol it contains, than ardent spirit; and the lighter wines much less, in the same relation, than the stronger, to which brandy has been added. Madeira has rather less than half the proportion of alcohol contained in brandy, and claret, according to Christison, about half as much as madeira; yet every one knows that two glasses of madeira are less intoxicating than one of brandy; and two of claret less so than one of madeira. It would seem, therefore, that distillation unsettles some association of the alcohol which has a strong influence in modifying its intoxicating power. Wine, moreover, operates more slowly as a cerebral stimulant than ardent spirit, and maintains its action longer; in other words, it is less diffusible and more tonic; and the same may be said of the lighter wines in relation to the stronger. The probability is, that the proper alcohol of the fermented liquors is capable of a more ready digestion and assimilation than that which has been distilled; and that, therefore, while it stimulates the brain less, it has greater efficacy in increasing and enriching the blood, and in promoting nutrition. The practical application of this fact, supposing it to be a fact, will be seen directly.

In relation to the several wines, the *lighter kinds* are more *diuretic*, and more disposed to be *laxative* than the stronger; and the *astringent* wines are more apt to produce costiveness than those not astringent, unless the tannic acid is associated with enough saline matter to counteract its effects. Thus, *port wine*, which is highly astringent, and not very acidulous, not unfrequently disposes to constipation, while *claret*, though it also contains tannic acid, is yet rather laxative than otherwise, probably through its bitartrate of potassa. *Burgundy* has been said also to be disposed to constipate in consequence of its astringency; but I have not found it so in practice. The *sparkling wines* are thought to be much more rapidly and powerfully intoxicating than the still wines of the same strength; carbonic acid being supposed to favour their influence upon the brain. But I am inclined to think that this difference has been over-estimated. Nothing is more true than that persons drinking champagne are vastly more apt to become excited than by the still wines of much greater strength; but, with careful observation, I think it will be found that this results much more from the quantity taken, and the rapidity with which, from its agreeable flavour, it is usually taken, than from the mere difference in quality. Yet I do not altogether deny that the sparkling wines are rendered more rapidly intoxicating by their carbonic acid. They are at first also more acceptable to the stomach; but, in their secondary operation, are very apt to discompose it, and to occasion headache, nausea, and other unpleasant sensations. This may in part be owing to the saccharine matter which accompanies them, and has a tendency to produce acidity of stomach; an objection to which sweet wines in general are liable.

Wines used habitually in excess are much more apt to produce gout, and uric acid lithiasis, than either delirium tremens, or chronic disease of the liver. The reason probably is, that, by stimulating less, and favouring the blood-making processes, either directly or indirectly, more than ardent spirit, they are more apt to induce the plethoric condition of the blood which favours these affections. Their injurious influence is very much diminished by vigorous exercise; and the resolute wine-drinker, if he have any regard for his health, should sedulously avoid a sedentary life.

Therapeutic Application. Wines may be employed for all the purposes for which alcoholic stimulation is demanded, and, as a general rule, are greatly preferable to ardent spirits. Almost the only exceptions to this rule are in the cases of the habitually intemperate, and in those instances of great prostration, or extraordinary insensibility to the effects of alcohol, in which the system refuses to respond to the influence of wine. For some local purposes, also, the distilled liquors are preferable. Only a few practical observations, therefore, will be required; and these few will refer rather to the choice of particular wines than to their general use.

When the habitual use of alcoholic drinks, in moderation, may be deemed advisable, as in those disposed to scrofula and phthisis, or labouring under these diseases without the complication of acute inflammation, the lighter wines should always be preferred to the stronger. Sauterne, claret, hock, or burgundy should be given preferably to madeira, sherry, or port. The object is here not cerebral stimulation, but a sustained tonic effect, the promotion of the digestive, assimilative, and nutritive functions, and perhaps more than all, that condition of the blood which experience has shown to be unfavourable to the tuberculous formation. I am not now treating of the relative value of wines and malt liquors, but of the choice between the different kinds of wine. In relation to the state of the stomach, when that is disposed to be disordered, I think burgundy will generally be found to agree with it better than the clarets or hocks, though probably somewhat more stimulant to the brain.

When, on the contrary, wine is required for a temporary purpose, and for its stimulant influence solely, the stronger wines should generally be preferred. They answer the indication more effectively, and are less apt to produce acescency, and otherwise to disorder the stomach. They are usually also better adapted to cases attended with dyspepsia. To fulfil the indications offered in the *low* or *typhoid states of fever*, and in general prostration from any cause, the stronger wines should be chosen. *Madeira* or *sherry* is, in general, preferable to the other stronger wines, and especially the latter, as being more free from acid. When, however, there is a coincident indication for astringency, as when *diarrhœa* exists, or *hemorrhage*, especially from the bowels, *port wine* should be preferably employed. When the *stomach*, in cases requiring stimulation, is *very irritable*, and rejects the other wines, *champagne* or *sparkling moselle* will sometimes answer an admirable purpose; but those varieties should be selected which are most free from saccharine matter, and in which the fermentation has been most nearly completed. The factitious champagnes might, under these circumstances, prove noxious, rather than remedial. When wines are required in cases presenting a joint indication for a *stimulant* and *diuretic*, as sometimes happens in *dropsy*, the *lighter acidulous wines* should be employed; and the same remark is applicable to enfeebled states of the system, with copious phosphatic deposition in the urine.

Wine-whey is an excellent preparation for use in all low fevers, in the debility which often attends the advanced stages of acute diseases, when the violence of the special disease is past, and in the same condition occurring at the close of incurable affections. Whenever stimulation is required in these cases, it is best, as a general rule, to begin with wine-whey, and advance to pure wine only after that preparation may prove inadequate to the demands of the case. It should be prepared by boiling a pint of milk, adding half a pint of wine while it is still boiling hot, and stirring until the mixture is complete. After coagulation, the whey should be strained off, and given generally without sweetening. Madeira or sherry should be employed in its preparation. The proportion of wine mentioned is requisite, in order to ensure perfect coagulation. If desirable, the whey may afterwards be diluted with solution of gum, or one of the amylaceous matters, or by rennet-whey. It has the advantage over diluted wine of being more nutritious, and often more acceptable to the patient.

The dose of wine-whey is, ordinarily, in low febrile cases, a wineglassful every two hours; but it must be diminished or increased, both in frequency and amount, according to the effects desired, and those produced. The stronger wines may be given in doses varying from a tablespoonful to a wineglassful, at the same interval. In chronic or protracted cases, the dose should, in general, be less frequently repeated. When the lighter wines are used, the quantity must be regulated altogether by their effects; but one strict rule should be adhered to; namely, never to allow their influence to proceed so far as to disturb the sound operation of the brain. To become intoxicated, or even to approach intoxication, would be quite unjustifiable in patients using these wines habitually for their health.

Wine may be given by enema, when, in consequence of irritation of stomach, it cannot be retained if swallowed. It has, indeed, been particularly recommended, in this mode of administration, in old and obstinate cases of exhausting diarrhœa.

2. MALT LIQUOR.—CEREVISIA.

This is prepared, by means of the vinous fermentation, from an infusion of *malt*, which is made from *barley*, by exposing it to a moderately elevated temperature with moisture, so as to promote germination, and then drying the germinated grain by artificial heat. In the germination of barley, there is first generated a nitrogenous principle called diastase, through the agency of which the starch of the grain is converted into grape sugar. This is extracted by infusion, and along with it a matter which is capable of acting as a ferment. Hops are added to the infusion, and the liquid is exposed to a temperature favourable to vinous fermentation. The result is malt liquor, which differs according to the quantity and character of the malt employed. Three prominent varieties are recognized; namely, *table beer*, *ale*, and *porter*. In the drying of the malt, it is exposed to different temperatures from 100° Fahr. upward. When dried at the lowest temperature, it undergoes little change of colour, and is called pale malt; at a greater heat, but insufficient to decompose it, the colour is changed to amber brown; and, at a high heat, it is roasted and charred, losing its characteristic properties to a considerable extent. In the preparation of ale, the pale malt is used; in that of beer, the brownish; and in that of porter, the same with the addition of some of the roasted malt to deepen its colour. Table beer, in which but a small proportion of malt is used, contains insufficient alcohol to preserve it, and is therefore apt to spoil in hot weather. It is unfit for medical use, and may be left out of consideration.

Composition. Malt liquor, besides alcohol and water, contains sugar, gummy and extractive matters, and gluten, derived from the malt; a bitter principle and volatile oil, from the hops; and lactic and carbonic acids, the product of the chemical change in fermentation. There are also various salts of little or no importance. The bitterness of the liquor is owing to the bitter principle of the hops, and its aroma in part to their volatile principle.

ALE owes its light colour to the paleness of the malt. According to the analysis of Brande, it contains on an average 6.87 per cent. by measure of alcohol of the sp. gr. 0 825, and of course has somewhat more than one-half the average strength of the light wines.

PORTER is very dark-coloured in consequence of the burnt malt used along with dried malt in its preparation. For the same reason it is somewhat weaker when prepared from an equal amount of malt; for the portion burnt has lost its virtues. The alcoholic strength of London porter, as given in Brande's table, is 4.20 per cent., of brown stout 6.80 per cent.

The carbonic acid in malt liquors is owing to the incompleteness of the fermentation when they are bottled. In consequence of having a smaller proportion of alcohol than the wines, they more readily become sour on exposure, and are often unfit for use.

Effects on the System. So far as their alcohol is concerned, these liquors do not differ from the wines in their effects; and the remarks made upon the modified influence of the alcohol as existing in the latter, are equally applicable to the former. But the malt liquors are richer in nutritive matters, leaving the alcohol out of consideration, than the wines, and have, in addition, the properties of the hops employed, which are actively tonic, and exercise a decided narcotic influence on the brain, producing a tendency to drowsiness. Hence ale and porter, while they are capable of stimulating to intoxication, are less enlivening and exhilarating than the wines, and more tonic and soporific. When perfectly sound, they usually agree well with the stomach; but in the dyspeptic, though the hops they contain act favourably on the digestion, they are not unfrequently injurious by their acescent tendency.

Therapeutic Application. The malt liquors may be used for the same general purposes as the wines; but they cannot compete with them in any case in which the stomach is in a delicate state; and are therefore generally unsuited to acute diseases. In the convalescence, however, from these affections, when the stomach is no longer diseased, they are often preferable to the wines, as less stimulating and more tonic.

For the same reason, they are better suited to chronic cases, in which the indication is for the habitual employment of supporting measures, as in scrofulous or tuberculous affections. Persons disposed to these complaints, or labouring under them, may often advantageously make use of ale or porter, to the amount of a pint or more in twenty-four hours.

They are also an excellent substitute for the stronger alcoholic drinks, when it is desired gradually to correct habits of intoxication; the hops they contain acting usefully towards obviating the wakefulness and nervous disorder, so apt to ensue upon a material diminution of the stimulus. But it must be understood that the porter or ale also must be ultimately withdrawn.

In the treatment of delirium tremens, it is often sufficient to allow the patient the free use of malt liquors in connection with the opium used;

or, if ardent spirit is employed, it should as soon as possible give way to these milder stimulants.

* * *

b. *Distilled Liquors.*

Under this head may be included all that is necessary to be said both of the ardent spirits, and the stronger preparations called in the U. S. Pharmacopœia simply *Alcohol* and *Stronger Alcohol*, and in the British, *Rectified Spirit.*

1. ARDENT SPIRITS.—*Proof Spirit.*

These are prepared by a simple distillation of the fermented liquors, and receive names according to the particular liquors from which they may be severally derived. Thus, the spirit distilled from wine is called *brandy;* that from a fermented solution of sugar, *rum;* and that from the fermented infusion of malted grains, particularly rye, is called *whisky*, or, if flavoured with oil of juniper, *gin*. There is little difference between these, in relation to the effects of the alcohol; but one is sometimes preferred for its flavour, or in consequence of some peculiarity of effect from peculiar impregnation, as in the instance of gin, which is more diuretic than the others from its oil of juniper. Medically, therefore, it is of little importance that the different forms of ardent spirit are now frequently prepared artificially from rectified spirit, by freeing this from fusel oil by passing it through charcoal, then reducing it with water to the requisite strength, and lastly, giving the desired colour and flavour by suitable additions.

Brandy (SPIRITUS VINI GALLICI, *U. S.*) is recognized in the U. S. Pharmacopœia as officinal. It varies somewhat with the character of the wine from which it is procured. French brandies have the highest reputation, and of these the *cogniac* and *armagnac*. Brandy, according to Brande, contains 53.39 per cent. by measure of alcohol of 0.825. It has, therefore, somewhat more than twice the strength of madeira and sherry wines, four times that of the light wines, and from eight to twelve times that of ale and porter. Besides alcohol and water, it contains a little volatile oil, colouring matter, œnanthic and acetic ethers, and a minute proportion of tannic acid. Its colour is sometimes deepened by the addition of burnt sugar.

Whisky (SPIRITUS FRUMENTI, *U. S.*) was introduced into the U. S. Parmacopœia, at the late revision, and from its very extensive medicinal use, very properly so. It is the spirit obtained by the distillation of the fermented infusion of rye, corn, or other grain. Its average strength is about the same as that of brandy, and its medicinal effects nearly identical, though it differs considerably in flavour. It may, therefore, if of good quality, be substituted in medical use for brandy, over which it has the advantage of being much cheaper. The Pharmacopœia requires that it should contain from 48 to 56 per cent. of absolute alcohol; so that its sp. gr. should not be greater than 0.922 at 60° F., nor less than 0.904.

Effects on the System. The effects of the ardent spirits have been already fully described in the general observations on alcohol. The consequences of their abuse are so fearful, that they should be banished altogether from customary use. Less apt than wines and malt liquors to cause gout, they much more frequently give rise to delirium tremens and meningeal inflammation, and, in their ultimate operation, if the many dangers by the way be escaped, to diseased liver, degeneration of various organs, and finally death with universal dropsy.

Therapeutic Application. The distilled liquors should never be employed, when the fermented will answer equally well, in consequence of the terrific dangers of their abuse. But occasionally they are necessary to the salvation of life. It is sometimes, in *low fevers*, advisable to introduce stimulus into the stomach in as concentrated a state as the organ will bear, when considerable quantities both of it and of nourishment are required. Thus, it is better, in such instances, to give a tablespoonful of brandy with two of milk, than an equivalent quantity of wine and other liquid aliment. The stomach receives better, and subsequently manages better, the material in smaller bulk. Again, cases now and then occur, in which the prostration and insensibility are so great that wine is powerless. Brandy or some equivalent liquor is then our only resource. In the *low diseases of drunkards*, it is necessary to stimulate with ardent spirit; as wine will have little more effect than water. In delirium tremens, it is not unfrequently necessary to use it to prevent death from sheer prostration. There are certain diseases, too, in which there is an extraordinary insusceptibility to alcoholic liquids; and enormous quantities are requisite to act decidedly on the system. This is often the case in *tetanus*, and it is said to be so in the state of system resulting from the *bites of venomous snakes*. Sometimes in *prolonged syncope*, and in *asphyxia*, it may be advisable to administer brandy, either by the mouth or the rectum.

In *dyspeptic affections* a little brandy often yields great relief to patients unaccustomed to its use. A teaspoonful or two will generally relieve the peculiar and distressing epigastric uneasiness of that complaint, and, taken at meal times, will facilitate the solution and digestion of the food. The relief, indeed, is so great, that the patient often feels an irresistible inclination to repeat the remedy; and as, from time to time by the gradual diminution of the excitability of the organ, it becomes necessary to increase the dose in order to obtain the same relief as at first, the patient is led on, almost without a suspicion on his own part, into confirmed habits of intemperance. Many a drunkard has probably owed a miserable death to the inconsiderate recommendation of a little brandy in dyspepsia. To obtain the same advantages with less danger, the bitter tinctures, as those of gentian, quassia, and columbo, may be prescribed, and so associated with other medicines, that the patient may not be able to trace his relief to the spirit. The aromatic spirit of ammonia, which is only alcohol holding a little carbonate of ammonia in solution, with aromatic oils, may also be substituted. In no case should the remedy be continued uninterruptedly and indefinitely.

Brandy sometimes affords quick relief in *gastrodynia*, pure *gastric spasm*, and *nervous colic.*

It is also sometimes useful in correcting the effects of *limestone water,* when no other drink can be obtained, and when this produces nausea and diarrhœa, as it is very apt to do with persons unaccustomed to it. In travelling in limestone regions, I have often found advantage from adding a single teaspoonful or two to a tumbler of the water. It covers the nauseous taste, and often corrects the purging tendency.

Brandy is much and very usefully employed externally as a stimulant and rubefacient. In all low states of the system, with a cool surface, it may be employed in the way of friction, and as hot as the skin will bear it. Under the same circumstances, it may be rendered more efficient by admixture with rubefacient medicines, as Cayenne pepper, and, when the case is complicated by spasmodic or other nervous disorder, with garlic. It may be used also, in the form of hot fomentation, to relieve internal abdominal pains, when associated with a depressed state of system. For the prevention of bed-sores, and excoriations from other causes, it is often applied with benefit by lotion to the skin; and Dr. Christison recommends particularly a mixture of brandy and the white of egg, to be applied to the part by a brush; the application to be repeated as each layer dries, until a coating of sufficient thickness is formed.

Brandy may be given diluted with water, or mixed with milk, in the form of milk-punch. The latter is an excellent remedy when there is a conjoint indication, as often happens, for stimulation and nutrition. The successive introduction of the milk in small portions, with stimulus enough to promote its digestion, has a very happy effect. For use in low fevers, one part of brandy should be added to two or three of milk; and the preparation may be given in wineglassful doses.

Under the name of MISTURA SPIRITÛS VINI GALLICI, or *Brandy Mixture,* the London College formerly directed a preparation consisting of brandy and cinnamon-water, each, four fluidounces, the yolks of two eggs, refined sugar half an ounce, and oil of cinnamon two minims, mixed together. If the cinnamon-water of the U. S. Pharmacopœia be used, there will be no occasion for the addition of the oil of cinnamon. Two or three tablespoonfuls may be given for a dose in low fevers, when brandy is indicated. The preparation has been omitted in the British Pharmacopœia.

2. ALCOHOL. *U. S.*—SPIRITUS RECTIFICATUS. *Lond.*—*Rectified Spirit.*

By the term alcohol, as before stated, the U. S. Pharmacopœia recognizes a spirit of the sp. gr. 0.835, prepared by distilling brandy or other form of ardent spirit. The corresponding British "rectified spirit" has the sp. gr. 0.838. Officinal alcohol is never used internally; but externally it may be employed as an evaporating lotion, applied on a single thickness of linen, so as to admit of free evaporation. By its chemical influence in the abstraction of water, it is thought to produce the shrinking of blood-vessels; and, when brought into contact with the blood, causes its coagulation. Hence it has been recommended for the suppression of hemorrhage by direct application to the bleeding vessels. But its chief value is as a chemical and pharmaceutical agent. From its solvent and preservative properties, it answers an excellent purpose for preparing tinctures of substances wholly insoluble in water. (See first part of this work, *page* 61.)

3. STRONGER ALCOHOL.—ALCOHOL FORTIUS. *U. S.*

This preparation is somewhat stronger than the preceding, having the sp. gr. 0.817. It differs also in being more completely destitute of fusel oil; and on this account was introduced into the Pharmacopœia, as a means of preparing other officinal substances, as ether, spirit of nitrous ether, etc. It is not used of itself medicinally, and is therefore of more importance to the pharmaceutist than the medical practitioner.

4. DILUTED ALCOHOL.—ALCOHOL DILUTUM. *U. S.*—SPIRITUS FORTIOR. *Br.*

This is prepared, according to the U. S. Pharmacopœia, by mixing equal measures of officinal alcohol and distilled water. It is not quite so strong in alcohol as the proof spirit of the British Pharmacopœia, or as ordinary full proof brandy. It is used chiefly in the preparation of tinctures, from substances containing active principles soluble both in water and alcohol. (See *page* 61.)

II. ETHER.

ÆTHER. *U. S.*, *Br.*

Syn. *Sulphuric Ether. Æther Sulphuricus.*

Ether is obtained by the distillation of a mixture of alcohol and sulphuric acid; but, as thus procured, it is impure, containing, besides the pure ether, sulphurous acid, ethereal oil, alcohol, and water. From these it is purified by redistillation from a strong solution of potassa.

Ether consists of the same ingredients as alcohol less one equivalent of hydrogen and one of oxygen, in other words, less one equivalent of water. This equivalent of water is abstracted by the sulphuric acid. Chemists differ as to the precise mode in which the end is attained; but the result is as stated. At the same time, a reaction takes place, by which a very small portion of the sulphuric acid is converted into sulphurous acid, and of the alcohol into heavy oil of wine, or ethereal oil. Hence the presence of these impurities in the product of the first distillation. In the second distillation, the potassa neutralizes the sulphurous acid, and abstracts any water that may be present; the alcohol is retained by the water, and the ethereal oil is either decomposed or remains behind. The ether obtained, however, still contains a little alcohol, from which it is not necessary that it should be entirely freed for certain medical purposes, especially as an external application. But for inhalation, it is important that it should be as pure as possible; and both the U. S. and British Pharmacopœias give processes for its purification; designating the resulting preparation by names denoting either its greater strength or purity.

STRONGER ETHER.—ÆTHER FORTIOR. *U. S.—Pure Ether. Br. Appendix.*

The process of the U. S. Pharmacopœia consists in first shaking unpurified ether and water strongly together, and, after subsidence, pouring off the supernatant ether, thus deprived of its alcohol; then agitating this with chloride of calcium and quicklime, in fine powder, so as to separate the water; and lastly, distilling off only a portion of the liquid. Even thus strengthened and purified, ether is not absolutely pure, as it still contains a little alcohol; but it is sufficiently pure for all medical uses. The British process is essentially the same.

Properties. Ether is a colourless liquid, having, when quite pure, the sp. gr. of about 0.712; but, as directed in our officinal code, it has in the crude state the sp. gr. 0.750, according to the British Pharmacopœia 0.735; and in the pure state (*æther fortior*) 0.728, *U. S.*, and 0.720, *Br.* In the latter condition, it should not lose more than from one-tenth to one-eighth by agitation with water; should boil actively when a test-tube half filled with it is held in the hand, and a small piece of glass is dropped into it; and, when half a fluidounce of it is moved backward and forward upon a porcelain plate, should yield a faint aromatic odour as the last portions are volatilized, and leave the surface of the plate without smell or taste, but covered with moisture. These are the officinal tests of its sufficient purity.

The odour of ether is strong, penetrating, and rather grateful; its taste, hot and pungent, yet somewhat cooling also. It is extremely volatile, rapidly escaping when exposed to the air, and producing cold during its vaporization. Its boiling point is extremely low, scarcely exceeding the heat of one of our hot summer days. It is also highly inflammable; and its vapour forms an explosive mixture with atmospheric air. Caution should, therefore, be observed not to allow the too near approach of flame when it is used. The affinity between it and water is not strong. Nine parts by measure of water will dissolve one part of ether; and, conversely, ether will take up about the same proportion of water. If mixed in other proportions, the two liquids will separate, the ether floating on the surface. It unites in all proportions with alcohol. On exposure to the air, it undergoes gradual decomposition, producing acetic acid and water. It should evaporate wholly on exposure, and should not become milky on being mixed with water.

Composition. All agree that ether consists of 4 eqs. of carbon, 5 of hydrogen, and 1 of oxygen (C_4H_5O); but, as to the precise mode in which its constituents are combined, different views have been entertained. According to the one most generally received, it is simply the oxide of ethyl, consisting of 1 eq. of ethyl (C_4H_5) and 1 of oxygen.

1. *Effects on the System.*

Ether is a universal and highly diffusible stimulant, closely resembling alcohol in its action, but much more speedy and less durable. When I say that it is universal, I do not mean that it absolutely stimulates every function at the same time; but only that there is no function which it is not capable of stimulating. Like alcohol, it more or less excites the secretions, and, as shown by Bernard, stimulates the sugar-producing function of the liver. (*Arch. Gén.*, Juin, 1856, p. 736.) Its operation is very evanescent.

Applied externally, and confined so that it cannot evaporate, it speedily produces burning pain with redness, and, if the application be continued, sometimes vesication. When taken internally, it occasions much irritation in the mouth and fauces, with almost suffocating sensations, arising in part from its vaporization; so that many persons find great difficulty in swallowing it. It leaves a burning sensation in the œsophagus, and produces the same feeling in the stomach. By its rapid evaporation, it fills the stomach with its vapour, which is often thrown up by the forcible contractions excited. Its influence is very quickly diffused over the body, causing an increased frequency of pulse, and excitement of the nervous system, especially of the brain, attended with a sense of fulness of the head and feelings of exhilaration. These are followed by drowsiness, and after a short time not unfrequently with perspiration, after which the effects pass off with more or less depression. Its operation in very large doses upon man is not well understood, because, in consequence of the difficulty of swallowing it, the instances are very few in which there has been an opportunity of observing its action when thus administered It is said, however, when taken excessively, to produce intoxication, nausea, giddiness, and stupefaction. That, if swallowed in very large quantities, it is capable of producing fatal narcotic effects, unless rejected from the stomach, is fairly inferrible from experiments which have been made upon the lower animals, and by its well-known action when inhaled. Orfila states that a dog, in the stomach of which half an ounce of it was introduced, and the œsophagus then tied, was rendered comatose, and died in three hours, presenting marks of inflammation of the stomach after death; and from four to six drachms of it proved sufficient, in the experiments of Brodie, to plunge a horse into deep lethargy. (*Mérat et de Lens*, iii. 166.)

Inhalation. Though long known to be capable of acting powerfully by inhalation, it is only of late that its effects, when given in this way, have been carefully studied. About fifty years ago, I remember well that it was a fashion among the boys in Philadelphia to inhale ether for its intoxicating effect, which resembled that produced by nitrous oxide. A teaspoonful or more was introduced into a large bladder, with a mouth-piece attached, through which the vapour was inhaled. One case of death with coma occurred, and several other cases of an alarming character, and the practice soon ceased. The first effect is ordinarily irritation of throat with coughing, which soon subsides, and is followed by marks of general stimulation; the respiration being quickened and more audible, the pulse usually increased in frequency, and the face more or less flushed. An agreeable exhilaration, amounting to intoxication, is now generally felt, which is sometimes quiet; but in other cases is attended with various muscular movements, occasionally amounting to convulsions. In a period of from two to five minutes, sometimes, however, prolonged to ten or even fifteen, sleepiness is produced, the eyes are closed, the voluntary muscles become relaxed, and the patient falls back apparently quite unconscious. The mind, however, is not wholly inactive; for the individual often afterwards speaks of curious dreams or visions, which seem to him to have been of long duration, and which, though occasionally disagreeable or even fearful, are for the most part very much the reverse; and, altogether, the effects are so pleasing that a repetition of the process is frequently desired. But, with an increased influence of the vapour, a deep comatose sleep is induced, often attended with snoring, in which there is an entire loss of consciousness. When the period of stupefaction commences, the pulse becomes slower, the skin relaxed, and the face palish or of a venous hue, which, as the stupor increases, may deepen into a dark suffusion. If the agent is omitted as soon as the stupor appears, this state subsides as quickly as it was produced; and, though there may sometimes remain a momentary confusion of mind, and slight languor of body for a short time, occasionally perhaps a little headache or nausea, the subject of the process soon returns to his previous condition, as if nothing had happened. In the period of excitement, it occasionally happens that the sexual function becomes the special seat of stimulation; and the delusions of the patient, or his dreams, may take a corresponding direction, and, even after the perfect return of consciousness, may remain impressed on the mind with the vividness of reality. This is a very important medico-legal fact. Should the inhalation be persevered in, there is risk of a suspension of the function of the respiratory centre in the medulla oblongata, and of death from asphyxia. Some instances of this kind are on record; but they are extremely rare. With ordinary care, and in an ordinary state of system, death can scarcely result from this cause under the influence of ether.* Indeed, I believe that the ethereal intoxication is much less dangerous even than the alcoholic. But an undue perseverance in its use, in cases which resist the stupefying influence of the ether, is sometimes followed by serious nervous disorders, and injurious if not dangerous sanguineous determinations, which may last for a considerable time, and should serve as a warning to the practitioner not to urge the measure, in all instances, and at all hazards, to entire stupefaction.

For many hours after the immediate effects of the inhalation of ether are over, there is an escape of its vapour from the lungs, and possibly from other emunctories, which is obvious to the senses of an observer, and which sometimes continues, according to my own observation, for one or two days or more. So striking is this effect, that a patient who has inhaled ether at bedtime, will often scent a large apartment next day with its odour. There is also sometimes a sensation of heat in the chest, attendant on the exhalation of the vapour, indicating that it is escaping by the lungs.

---

* But very few cases of death, under the influence of ether used as an anæsthetic agent, are on record. I have seen a detailed notice of but one case. It was that of a woman in New York, for whom the inhalation of ether was used to relieve violent pain in the head. A large tumour was found in the cerebellum, which was probably the real cause of death, perhaps aided by the additional stimulus of the ether, which had been given three times previously without unpleasant effects. (See *Bost. Med. and Surg. Journ.*, lxi. p. 245.) In the same journal (liii. 231), a case of hemiplegia is recorded following the use of ether, given in anticipation of a surgical operation. When it is considered how extensively ethereal inhalation is used in this country, both by surgeons and dentists, it is remarkable that accidents have not been more frequent. At a meeting of the Imperial Society of Medicine, of Lyons, Dr. Barrier stated that, to his knowledge, there were only three well authenticated cases in which ether had caused death, and that in these there were extenuating circumstances. (*Pharm. Journ. and Trans.*, July, 1859, p. 41.)—*Note to the second edition.*

Since the publication of the last edition of this Treatise, though a very few cases of death following the use of ether have been recorded, I have seen none, in which the details were given, which could be ascribed to the direct and unmixed influence of the ether, or which ought to deter from the use of this anæsthetic in cases not obviously unsuited to it, as in those with existing disease of the brain, or with a strong predisposition to it. See on this subject a paper by Dr. F. D. Lente, in the *Am. Journ. of Med. Sci.* (April, 1861, p. 360).—*Note to the third edition.*

There are two points, in connection with the influence of ethereal inhalation, which, though strictly pathological, and, therefore, not belonging exactly to the physiological effects of ether, may be most conveniently considered in this place, in order that the whole series of facts in relation to the influence of the process may be presented in one view. I allude to the anæsthetic influence of etherization by the lungs, and that which it exercises in relaxing spasm.

That ether is capable, when inhaled, of *abolishing sensibility*, is an obvious corollary to its stupefying power. The sense of touch, as well as every other special sense, is, in the very nature of the case, suspended in coma. This, then, is no new discovery. But it was not so obvious that the general sensibility might be diminished, and even quite suspended, while consciousness, and, to a considerable degree, the special senses, remain unaffected. This, however, is a most important fact in relation to etherization. Under the influence of this agent, pain is often abolished if existing, and averted when it would otherwise have been produced, before the occurrence of any degree of stupor, or of any considerable anæsthesia of hearing, sight, etc. The woman in childbed ceases to suffer from her labour-pains, though still conscious; the patient under the knife of the surgeon sometimes scarcely suffers, though he may follow every step of the operation; and the pain of violent spasm is subdued as by a charm, without the least degree of apparent stupefaction. An eminent medical gentleman once assured me that, while labouring under the most exquisite pain from spasm of the bladder, he had inhaled ether, with the effect of completely relieving the pain, though he retained his consciousness unimpaired, and even took pleasure in noting the return of each contraction of the bladder, of which he was distinctly sensible, though it was quite painless.

The other point referred to was the efficacy of ether when inhaled in *relaxing spasm*. That it should have this power, in reference to the voluntary muscles, so far as the cerebral centres are concerned, was almost inferrible from the property it evinces in health of relaxing these muscles, when the system is brought completely under its influence. But the muscles of organic life usually remain unaffected, at least not materially affected, in the stupefaction, unless carried to the last degree short of absolute death. Respiration goes on; the peristaltic movements, so far as is known, are not impaired; the sphincters generally act as in health; and the uterine contractions during labour are undiminished in force, though no longer painful. But over the morbid contractions of these muscles, over their spasmodic conditions, for example, etherization has great control. It is capable not only of relieving the pain of these spasms, but, in a somewhat higher degree of its action, of relaxing the spasms themselves. Though, as before stated, the spasm will sometimes continue after the pain has ceased, yet the two often cease together, and, when this is not the case, the muscular relaxation generally soon follows the anæsthetic effect. This only proves that the nervous centres of pain, and those of the involuntary movements, are not the same, and that the former usually come under the influence of the anodyne before the latter. The pains of tetanus, for instance, cease before the muscular spasms, but these also will often yield, temporarily at least, to ether. In their tetanic movements, the muscles cease to be voluntary muscles; and are under the control of the spinal centres. From all this, it may be physiologically deduced that, in etherization, the nervous centres of organic life, those, namely, of the spinal marrow, and the sympathetic ganglia, either come last under the power of the stupefying agent, or, to speak more precisely, are the least susceptible to its action.

Another valuable therapeutic agency of ether by inhalation is the *relaxation it often produces in the mucous tissues*, with an increase of the mucous discharge. This has been noticed in the mucous membrane of the generative organs of women in childbed, and in the bronchial tubes, and may possibly extend to the others; as it is probably rather through the organic nervous centres that it acts, than directly on the tissue affected.

Judging from the effects above detailed, we may pretty certainly conclude that the cerebral centres of general sensation, and those of thought and emotion, are most susceptible to the influence of ethereal inhalation, that next in order are those of special sensation and the will, and that lower still in the scale of susceptibility are the centres of organic force, of which the respiratory centre in the medulla oblongata is the lowest.

Perhaps there is no powerful remedy to which the system becomes more speedily accustomed than this; so that, to sustain a given effect for a long time, it must be administered on successive occasions, in rapidly increasing quantities; and the amounts which have been given, in some cases, without material injury, are almost astounding, considering the powerful effect produced at first by a small quantity, and the rapidity with which the larger amount has been reached. Even while the ether, which may have caused all the characteristic phenomena, still remains in great measure in the system, it has quite lost its effects on the cerebral centres; for the breath continues to smell of it long after all the phenomena of its action have disappeared. The previous habit of using alcohol or opium also greatly lessens the susceptibility to the impression of ether, showing a close resemblance between these three cerebral stimulants in their mode of action.

The only morbid appearances noticed after death from ether are those incident to asphyxia; namely, darkness of the blood, fulness of the right cavities of the heart, and congestion of the brain, lungs, etc.

In *poisoning* from ethereal inhalation, the shock of cold water upon the face, head, or shoulders, and the introduction of pure air into the lungs by artificial respiration, are probably the most efficient measures. When the prostration is great, the ammoniacal stimulants may be resorted to by the mouth or rectum, and external stimulation by rubefacients should not be neglected.

2. *Mode of Operating.*

Ether probably operates as a stimulant by a direct influence on the vital susceptibilities of the tissues, without any chemical reaction. One proof of this is the vast amount which may be taken with impunity, after the system has become accustomed to it, by a gradual increase of the dose. The case of a chemist is recorded, who took a pint of ether daily. (*Mérat and De Lens*, iii. 166.) When large quantities have been introduced by inhalation, the observable effects often cease long before the evidence afforded by the breath that a portion still remains in the system. This could scarcely be, if the effect were chemical, whether on the solid tissues, or the blood. The higher carbonization of the blood has been supposed to have something to do with the effects of ether. This, however, is probably a mere respiratory result. That the first stimulant impression on the circulation, respiration, and cerebral functions, may depend on the propagation of the local influence, through the nerves, to the nervous centres of those functions, is not impossible; and the rapidity with which the effect is produced might be advanced as an argument in favour of this view; but experiments have satisfactorily shown, that the round of the circulation is accomplished in time to permit the operation by this route within the actual period; so that the view referred to cannot by any means be considered as demonstrated. The probability is that most of the effects of ether are due to its absorption into the circulation, and direct action upon the nervous centres, the functions of which are first increased by the stimulation, then deranged, and afterwards diminished or temporarily suppressed, under the general law of irritation. I have already referred to the relative degree in which the centres are susceptible, deduced from the period at which they respectively come under its influence. That ether is absorbed, is almost too obvious to require proof. The odour of the breath, which always smells strongly of ether, in whatever way administered, is a sufficient evidence; not to allude to the fact, that its odour has been noticed in the ventricles of the brain, when death has from any cause followed soon after its exhibition. The great difference in the effects of the medicine, as administered by the stomach and the lungs, is probably owing to its much slower absorption from the former organ. Its powerful direct stimulant action, in the liquid state, upon the stomach, producing an active congestion of the blood-vessels, may be one reason of its relatively slower absorption through this organ than the lungs, when compared with some other volatile medicines, such as hydrocyanic acid.

3. *Therapeutic Application.*

The use of ether as a medicine dates from an early period in modern history. I shall treat of its employment first as administered by the stomach, secondly by inhalation, and lastly as an external application.

1. *Use by the Stomach.* In the course of *low fevers*, especially of malignant typhus, in cases of *delirium tremens*, and in other diseases of debility, *sudden sinking spells* occasionally take place, approaching asphyxia in character, which require prompt and energetic stimulation of the nervous centres. In such cases ether is strongly indicated, and may be given in connection with carbonate of ammonia, or the aromatic spirit of ammonia, in order as speedily as possible to restore action, which may then be sustained, if necessary, by the more permanent stimulants and tonics. In the *poisoning by mushrooms* it has been recommended, probably upon similar grounds.

A similar condition sometimes occurs in *angina pectoris*, and demands instant interference to prevent death. Here also ether is highly valuable in connection with other medicines. In the *seemingly spasmodic pains of that affection*, in which it would appear that sudden cramp had seized on some portion of the cardiac muscles, and during which the whole system is extremely prostrate, ether and laudanum are the internal remedies mainly to be relied on. Such a condition occasionally takes place in *nervous gout*, constituting probably the most dangerous example of that disease.

The prompt and powerful stimulation with which ether operates upon the nerves adapts it admirably to those spasmodic affections, unattended with acute inflammation, which are characterized by great depression of the circulation, coolness and dampness of the surface, and apparent general prostration. Hence its usefulness in *violent spasms of the stomach, and of the bowels*, attended with feeble pulse, cold skin, etc., in which it may often be advantageously combined with laudanum or other liquid preparation of opium, and given in teaspoonful doses. The same remark is applicable to *spasms of the ureters and of the gall-ducts*, occasioned by the passage respectively of urinary or biliary calculi. In the latter affection, it has been supposed to be peculiarly useful when combined with oil of turpentine. Upon the same grounds, too, it is indicated in the *approaching collapse of cholera*, attended with internal and external cramps. Its powerful stimulation of the nervous centres, in these cases, may be supposed to rouse them from the torpor into which they appear to be thrown by the concentration of the nervous energy in the suffering organ, and thus to act revulsively in the relief of the spasm.

In the paroxysm of *spasmodic asthma* it has sometimes been used beneficially, though less efficient in this disease than some other remedies.

In small doses, ether acts purely as a nervous stimulant, and is much employed for the relief of various mild nervous affections. For this purpose it is usually prescribed in the form of *compound spirit of ether*, or *Hoffmann's anodyne*, under which this highly useful application of the remedy will be more particularly noticed.

Ether has also been recommended in *sea-sickness*, in which a teaspoonful of it may be given in a glass of sherry or madeira wine.

M. Bourdier has employed it with success for the *expulsion of the tapeworm*, giving it both by the stomach and rectum with an infusion of male fern, and following it in an hour by a dose of castor oil. M. Lortet also has had favourable results. In five cases, all in which he had tried the remedy, he gave 60 grammes (nearly two troy ounces) of ether at once, followed in two hours by half the quantity of castor oil. In every case, the worm was discharged without suffering, and always either entire or nearly so, including the head. (*Ann. de Thérap.*, 1860, p. 281.)

Ether is *contraindicated* in all cases of sthenic febrile action and acute inflammation, especially of the stomach and brain.

Administration. The dose of ether is from half a fluidrachm to two fluidrachms, which, if a given effect is to be sustained, should be repeated at intervals of half an hour, or at most one hour, as the effect rapidly passes off. It may be given in one or two wineglassfuls of sweetened water, well mixed at the moment of administration, and taken cold. A useful method of dissolving it in water for exhibition, suggested originally, I believe, by the late Dr. Joseph Hartshorne, of Philadelphia, is to rub it up with spermaceti, two grains being used to each fluidrachm, then to rub this mixture well with water, and to strain. As water will take up about one-ninth of its bulk of ether, the dose ought to be readily dissolved in a wineglassful of that fluid. In France, a *syrup of ether* is prepared by putting one part of the ether and sixteen of syrup in a flask, with a tubulure at the lower part on the side, fitted with a cork, through which passes a short tube, the outer extremity of which is closed with a small cork. The mixture is shaken occasionally for four or five days, and then allowed to stand. The syrup, at first turbid, afterwards becomes clear, with a portion of the ether floating on the top undissolved. It is drawn off through the tubulure when wanted for use, and a fluidounce may be given at a dose. (*Trousseau and Pidoux*, 4e ed., ii. 260.)

2. *Use by Inhalation.* Ether has long been used in this method. The late Dr. P. S. Physick was much in the habit of employing it in pulmonary affections, and invented a small extemporaneous inhaler for the purpose. It is only as an anæsthetic agent, that any claim to discovery has recently been advanced in reference to its exhibition by the lungs.

The way to this discovery had been gradually opened by attempts to effect the same object by other agents, and especially by the favourable result of some trials with nitrous oxide by Dr. Horace Wells, of Connecticut; but the credit of the first application of ether to this purpose must be ascribed to Dr. W. T. G. Morton, of Boston. It was in October, 1846, that the attention of the profession was called to this highly important discovery. The process was originally applied by Dr. Morton to the relief of pain in dentistry. He made known his success to the late Dr. John C. Warren, who was the first to test its efficacy in an important surgical operation.

Though first used to prevent pain in surgical operations, this mode of administering ether may be resorted to in a wide circle of spasmodic, convulsive, and neuralgic affections. Of the painful spasmodic diseases, it may be used advantageously in *spasm* of the *stomach*, *bowels*, *bladder*, *ureters*, *gall-ducts*, and *diaphragm*, in *violent external cramps* as those of cholera, and in *tetanus*. In the atrocious affection last named, it will generally afford more or less relief, and sometimes contributes to the cure. In the *poisoning from strychnia* it is also indicated. In *infantile convulsions from spasm* of the bowels, it should be resorted to if other means fail.

The measure has been recommended in *chorea*, *pertussis*, and the *convulsive affections* of hysteria; but, as it will seldom cure these complaints, but only afford temporary relief, there may be danger of inducing a bad habit of indulgence, without corresponding benefit. I have used it with apparent advantage in peculiarly violent or obstinate hysterical convulsions, but, as a general rule, it would be more prudent to dispense with it. For the relaxation of spasm, it may also be employed in dysphagia from *spasm of the œsophagus*, and in *strangulated hernia*.

In the *paroxysm of spasmodic asthma*, when not complicated with acute bronchitis, it may be tried with good hope of benefit; and in the *dyspnœa dependent on chronic bronchitis* it is doubly useful, if carefully managed, both by relieving the distressing sensation, and favouring mucous secretion. In these cases the remedy should not be pushed to positive insensibility.

Neuralgia, *dysmenorrhœa*, *angina pectoris*, and *severe* or *obstinate nervous headaches*, are complaints in which the remedy is indicated for its anæsthetic virtues.

In *delirium tremens* it sometimes powerfully co-operates with opium in producing sleep, and may be tried in obstinate cases.

It has been used also as an antiperiodic in *intermittents*, and there can scarcely be a doubt, that it would frequently interrupt the paroxysms if applied about the expected period of their approach. It is, however, only in exceptional cases that there can be any occasion for its use. I would recommend that it should be tried in otherwise desperate cases of the *pernicious paroxysm* of miasmatic fever, when not attended with comatose symptoms.

A case has been reported by Dr. J. H. Hutchinson, of Philadelphia, one of the physicians to the Episcopal Hospital of that city, in which a young woman of twenty years was completely cured, by repeated inhalations of ether, of deafness and dumbness, probably hysterical, after a duration of several months. (*Am. Journ. of Med. Sci.*, April, 1864, p. 412.)

As an Anæsthetic Agent in Surgery. There has been no little controversy about the propriety of using measures to prevent pain in surgery; but the mass of the profession, influenced in some degree, no doubt, by the powerful instincts of our nature, have come to the conclusion that such measures are not only admissible, but very often advisable. The advocates for their use maintain, and, as appears to me, very reasonably, that not only is the suffering of the patient mitigated if not entirely prevented, but that, in severe operations, the measure proves positively salutary, and conduces to a favourable result by obviating the shock on the nervous system, which is sometimes fatal even during the operation. The objection on the score that nature intended that there should be pain in surgical operations, if it need an answer, is fully met by the simple counter statement, that nature has also presented us with a remedy for the pain. The notion that ether might act injuriously by depraving the blood, and retarding the healing process, has proved as groundless on trial, as it really was in theory. The opium which almost every surgeon formerly gave, left a much more powerful impression on the system than the brief action of ether could do; and yet no one supposed that it prevented the healing of wounds. Another objection to the use of ether has been the doubt, whether it really exercised the anæsthetic influence ascribed to it, as patients, by their agitation during the operation, seem to evince some degree of suffering. But when, as has often happened, they have retained sufficient consciousness of what was going on to give an authoritative statement in the case, they have almost uniformly declared that they felt no pain or very little; and the agitation was really ascribable to some dreamy delusion at the time, or merely to reflex action. The only real question, as it seems to me, is whether ether can be given safely; for I doubt whether we have the moral right to relieve pain, at any appreciable risk of life. Reasoning from our knowledge of the effects of ether, I should say that a full dose of it, sufficient to bring on the state of anæsthesia, is less dangerous than a full soporific dose of opium, supposing in both cases the system to be in health. Etherization is certainly less dangerous than intoxication from alcoholic liquor, as the circulation is disturbed less, and the influence is much shorter in duration. Nor has experience contradicted the suggestions of reason. The instances are extremely rare, if in fact there are any on record, in which etherization, employed to prevent pain in operations, has proved fatal when the measure was judiciously applied, and the case properly selected. The measure itself is certainly not accountable for the ignorance or carelessness of the person who employs it, and should not be rejected on this score, any more than opium or mercury, or even quinia, should be rejected for the mischief they have often done in reckless and unskilful hands. Indeed, considering the number of instances in which ether has been used, even by the most notoriously ignorant persons, it is somewhat surprising that we have heard so little of its mischievous effects. This assuredly cannot be said of chloroform, which our professional brethren in Europe cling to with so much pertinacity, notwithstanding that almost every journal comes to us burdened with some fatal case, and it is presumable that many happen which never find their way into the public records.

Ether has also been much employed to mitigate or annul the pains of childbirth. Upon the propriety of this application of it, there has been even greater difference of opinion, or rather there has been greater opposition to the measure, than in reference to its use in surgery. Having no practical experience of my own in this branch of our profession, I feel altogether incompetent to give an opinion upon the subject, and allude to it here as a point in the history of etherization which cannot be wholly overlooked.

Cautions. Ether should not be recklessly used. In cases of seriously diseased heart, active congestion or acute inflammation of the lungs, brain, or stomach, organic cerebral disease, apoplectic or active hemorrhagic tendencies, or a generally plethoric condition, it should either be avoided altogether, or used only after a careful preparation of the system. It should be carried no further than is sufficient for bringing about the state of anæsthesia, and should be at once withdrawn, if a failing pulse indicate any danger of asphyxia. The utmost care should be taken that sufficient atmospheric air is inhaled. The want of this is probably the greatest danger of the process under unskilful management. The patient, by the very state of insensibility into which he is thrown, becomes incapable of giving warning through his feelings of suffocation; and hence the greater necessity for care on the part of the operator. The rule simply is that, while the vapour of ether is admitted into the lungs, it should be accompanied with free access of the atmospheric air.

Various instruments have been invented to meet the requisitions of convenience and safety in inhalation; but probably nothing is better, on the whole, than a large piece of sponge, hollowed out on one side so as to admit the nose. This should be applied saturated with the ether, so that the vapour may enter with the air drawn by inspiration into the lungs. In this way a due supply of atmospheric air is ensured; and the only disadvantage is, that more of the ether is lost by evaporation than when it is confined within an instrument. The patient should breathe preferably through the nostrils. Bags containing ether should never be used.*

When an instrument is used confining the ether, from one to two fluidounces may be employed; when a sponge, the quantity should be doubled. The operator should keep his fingers on the pulse, and, if he find it failing, should withdraw the ether. Should convulsions supervene, he must also suspend the process.

3. *External Use.* Ether is used externally for two purposes, for stimulation, and refrigeration. For the first, it is confined to the part to which it is applied; for the second, it is allowed freely to evaporate so as to lower the temperature.

In *neuralgic pains*, *nervous headache*, and *nervous earache*, it may be applied near the part affected, by means of a compress saturated with it, and then covered by a piece of oiled silk, to prevent evaporation. Sometimes a little of it, applied to the forehead, and held there in the hollow of the hand, will prove rapidly serviceable in nervous headache. It very quickly produces burning sensation and redness. In earache it is said sometimes to afford instantaneous relief, when dropped into the external meatus. Among the external uses of ether may be mentioned its application to the nostrils in cases of faintness, or even positive syncope, in which it will often do good by its pungency.

Ether dropped into the external meatus is asserted to have repeatedly cured deafness; and, when this is purely functional, we may readily admit that it might yield to the remedy. The practice originated with a French lady, Mademoiselle Cléret, who, having used the ether advantageously in her own case, afterwards tried it with marked effect in a number of deaf and dumb children. Her statements were submitted to a commission, composed partly of medical men, who after a sufficient examination, and some trials, reported favourably of the remedy. (*Gaz. des Hôpitaux*, Mai 8, 1860.)

Dr. John J. Black, of Philadelphia, having been induced, by the successful use of ether locally in aphthous affections of the mouth by Dr. Jules Worms, to give the remedy a trial in other local diseases, reports very favourably of its efficiency in aphthous ulcerations, in thrush, in ulcerous stomatitis, acute pharyngitis or ordinary sore-throat, diphtheria, and various chronic ulcers. The ether was applied by means of a camel's-hair pencil: and, though it sometimes occasioned a stinging pain at first, this was soon followed by an agreeable coolness and marked relief. In ordinary angina, one of its most striking effects was the rapid subsidence of the swelling, with decided relief to the patient. (*Am. Journ. of Med. Sci.*, April, 1866, p. 356.)

---

* For the description of an apparatus, very advantageously applied by Dr. F. D. Lente, of Cold Spring, N. Y., to the production of anæsthesia for surgical purposes, see the *N. York Med. Journ.* (Jan. 1866, p. 262). Its advantages are that it saves the ether, and by ensuring a more steady and thorough application of the vapour, shortens the time preliminary to the anæsthetic effect. In a case in which it was used at the N. Y. Hospital, the patient was completely insensible in a minute and three-quarters, and the quantity of ether used was only an ounce and a half. (*Note to the third edition.*)

With a view to *local refrigeration*, ether may be used in any case where this effect is required upon the surface of the body; the cuticle being sound. It is employed, however, chiefly in *headaches* with external heat, and in superficial *burns* or *scalds*. It may be dropped on the part, or applied on a single layer of thin muslin or linen. In strangulated hernia, it has been much commended; the object being, in this case, to produce contraction of the strangulated part, and thus enable it to pass back through the opening. It is applied most effectually by letting it fall upon the seat of the hernia in a slender stream. A considerable reduction of the temperature can be obtained in this way.

Since the publication of the preceding edition of this work, a new method of obtaining the refrigerating effect of ether, locally applied, has been introduced into use by Dr. Richardson, of London. It consists in causing the liquid to fall upon the part to be refrigerated, in the form of spray, by means of the atomizer. The cold produced is so great that the tissue may be frozen to a considerable depth; and advantage has been taken of the local anæsthesia which attends the congelation, to perform surgical operations without pain. More will be said on this subject when the anæsthetic effects of cold are treated of.

◆

There are two officinal preparations of ether which require notice, viz. the *Spirit of Ether*, and the *Compound Spirit of Ether*.

1. SPIRIT OF ETHER.—SPIRITUS ÆTHERIS. *Br.*—*Spirit of Sulphuric Ether.*

This is simply a mixture of one part by measure of ether and two of rectified spirit, or officinal alcohol. The only advantage of the preparation is that it is readily miscible with water, and may, therefore, be taken more conveniently than pure ether. The dose of it is two or three fluidrachms.

2. COMPOUND SPIRIT OF ETHER.—SPIRITUS ÆTHERIS COMPOSITUS. *U. S.*—*Compound Spirit of Sulphuric Ether.*—*Hoffmann's Anodyne Liquor.*—*Hoffmann's Anodyne.*

As directed in the Pharmacopœia, this is made by mixing together half a pint of ether, a pint of alcohol, and six fluidounces of ethereal oil or heavy oil of wine.

The *Ethereal Oil* (OLEUM ÆTHEREUM, *U. S.*), or *heavy oil of wine*, is a yellowish liquid, heavier than water, of a penetrating peculiar odour, and a sharp bitterish taste, and boiling at 536° Fahr. It contains sulphuric acid, combined with certain products of the decomposition of alcohol acting as a base or bases, and is considered by Liebig as a double *sulphate of ether and etherole;* the latter being another name for *light oil of wine*, which is a 4–4 carbo-hydrogen (C_4H_4). It is obtained by distilling a mixture of alcohol and sulphuric acid, the latter being in much larger proportion than is used in the preparation of ether. A portion of it is usually produced in the process for procuring ether, especially towards the close, and hence contaminates that product as obtained by the first distillation.

But, though precise rules are given for the preparation and use of the ethereal oil in the Pharmacopœias, it is in fact seldom properly prepared in this country; and the product sold as *Hoffmann's anodyne*, in our shops, is asserted to be sometimes prepared by continuing the distillation in the process for procuring ether, after it has been stopped in reference to the latter product. A mixture is thus obtained of ether, alcohol, and oil of wine, which is somewhat modified to make it suit the views of the manufacturers, and sold as Hoffmann's anodyne. It contains the ingredients of the officinal preparation, but much less of the ethereal oil.

Compound spirit of ether has a peculiar odour, which it owes to the ethereal oil. In taste it is very hot, pungent, and somewhat sweetish. It should be completely volatilizable by heat and destitute of acid reaction; and, when mixed with water, should have a somewhat milky appearance, owing to the separation of the oil.

Medical Uses. The effects of Hoffmann's anodyne on the system are essentially the same as those of ether, but somewhat modified by the oil of wine, so as perhaps to bring it more nearly into accordance with the class of *nervous stimulants.* Ether itself, in small doses, insufficient to disturb specially the cerebral centres, is really a nervous stimulant; and, were it used only by the stomach, might perhaps be ranked appropriately with this class of medicines; as it is never given in this way for its narcotic effects. But used, as it is at present by inhalation, prominently as a cerebral stimulant, and conforming so closely in its effects, as thus administered, with alcohol and opium, it could not with propriety be removed from this connection.

Hoffmann's anodyne is much used to quiet nervous irritation in its various forms. Among other effects is that of producing *sleep;* but this it does only when sleep is prevented by nervous discomposure; so that it acts, not directly on the brain as a narcotic, but simply as a general stimulant to the nervous system, equalizing its actions, and thus removing the cause of wakefulness. From its common name it might be supposed to have extraordinary powers of *relieving pain.* If given in large quantities, it might possibly produce this effect directly, as the vapour of ether does when inhaled, by rendering the cerebral centres insensible to the irritations which occasion pain. As ordinarily given, however, it does not act in this way, but only by quieting the irritation upon which the pain may depend; and, when this is beyond its powers, it is itself inoperative as an anodyne. In painful affections, therefore, purely dependent on functional disorder, it will occasionally afford relief; in the pains of a surgical operation, and those dependent on inflammation, or even active congestion, seldom or never in any ordinary dose. Mild spasmodic affections will not unfrequently yield to it.

It is much used in *febrile diseases* to calm restlessness, and general malaise, to obviate the nervous twitchings and startings so common in children, and to produce sleep, when the patient is wakeful. In the low or typhoid fevers, it is particularly indicated for the subsultus tendinum, and mild delirium so common in those affections. In all the slighter *troubles of hysteria*, in *faintness, languor, lowness of spirits, palpitations*, etc., and in analogous affections in the male sex, Hoffmann's anodyne is often an admirable aid to the physician, when more powerful remedies are not indicated.

Flatulent colic, singultus, and *gastric uneasiness*, will frequently be relieved by it.

It is often an efficient remedy in *nervous headache.*

It might be employed, in very large doses, for obtaining those more powerful effects in spasmodic diseases for which ether itself is given; but the proportion of alcohol it contains must always be taken into account in such cases.

When laudanum sickens the stomach or occasions headache, the effect may sometimes be obviated by giving Hoffmann's anodyne along with it.

The dose is from half a fluidrachm to two fluidrachms. Sometimes it produces very pleasant effects in restlessness, in the dose of from thirty to sixty drops. It should be given in a wineglassful of water, sweetened or not as the patient may prefer. The dose may be repeated every hour or two if required. It is often usefully combined with solution of sulphate of morphia, or other preparation of opium, in affections in which both medicines are indicated.

◆

III. NITROUS OXIDE

Syn. *Protoxide of Nitrogen. Laughing Gas.*

Though not yet recognized by the Pharmacopœias, nitrous oxide possesses such valuable properties, and is at present so largely employed, that it cannot be passed over in silence in a work, purporting to represent the Materia Medica in its existing state. It was discovered by Dr. Priestly in 1776, but attracted little attention until, in 1800, Sir Humphrey Davy made known the remarkable exhilarating property which gave it the name of *laughing gas.* Even after this time, notwithstanding the excitant powers exhibited by it, and some futile attempts to take advantage of these powers therapeutically, it was scarcely looked on in the light of a remedy until its application, in 1844, by Dr. Horace Wells, of Connecticut, to the purposes of an anæsthetic in dentistry. Since that period, though for a time neglected, it has risen into great importance, partly as a therapeutic agent through the investigations of Dr. Geo. J. Ziegler, of Philadelphia, but chiefly as an anæsthetic, in which capacity, it is due to the dentists to say they have taken the lead in its practical use.

Preparation. The most convenient method of preparing nitrous oxide is by the decomposition, by means of heat, of nitrate of ammonia, which for this purpose should be very pure. The salt is exposed in a glass retort, by means of a lamp or sand-bath, to a heat not exceeding 400° F.; and the gaseous product collected in a glass reservoir, over a saturated solution of common salt, as pure water absorbs a considerable proportion of the gas, and much loss might be incurred in using it. Warm water, however, absorbs much less than cold, and is often employed for the purpose. When nitrate of ammonia is heated, it is entirely decomposed; the hydrogen of the ammonia forming water with three equivalents of the oxygen of the acid, and the nitric oxide thus liberated, combining with the liberated nitrogen of the ammonia to generate nitrous oxide; so that this gas and water are the sole results of the decomposition, if the process is properly conducted. But there are two sources of impurity which must be guarded against. In the first place, if too much heat be employed, which will be known by the rising of white fumes in the retort, other products will be evolved, especially nitric oxide, uncombined ammonia, and possibly a little nitric acid; all highly injurious in their effects when inhaled. Secondly, nitrate of ammonia is apt to contain a portion of muriate of ammonia, or other impurity, in consequence of which chlorine may be among the products. To separate these impurities, which would unfit the gas for use, it should be passed, on leaving the retort, successively through a saturated solution of protosulphate of iron, and a solution of caustic potassa or soda, the former of which will remove the nitric oxide, and the latter, chlorine and whatever acid may be present. The gas thus purified may be kept in gasometers for use; or, as suggested by Dr. Ziegler, it may be forced into water, which can be made to take up five times its bulk, and kept indefinitely in this state. When wanted for use, nothing more will be necessary than to heat the water thus impregnated, which will yield the gas with great rapidity.

Properties. Nitrous oxide is a colourless gas, inodorous, slightly sweetish, and of the sp. gr. 1.527. Water at ordinary temperatures will absorb about three-fourths of its volume, and under pressure will take up much more; and, thus impregnated, has a slightly sweetish taste, and a feeble not unpleasant odour. The gas supports combustion vigorously, and for a time will support respiration, having thus a great advantage over other anæsthetics, which have no power of sustaining life. By the combined influence of cold and pressure, it may be condensed into a liquid, which is colourless, very mobile, and capable of retaining its form, without pressure, at about negative 9° of Fahr. Nitrous oxide consists of one eq. of nitrogen and one of oxygen, and its formula is NO.

Medical Properties and Uses. Nitrous oxide has all the physiological properties which entitle a medicine to rank among the cerebral stimulants. In whatever mode introduced into the system, it especially stimulates the cerebral functions. But it has another important property, wholly independent of its powers over the nervous centres; that, namely, of directly oxygenizing the blood, which renders it highly useful in several morbid affections. Its exhilarating effect on the spirits, and the species of intoxication or delirium induced by it when inhaled, have been rendered familiar to every one through the public exhibition of its extraordinary powers in this respect. The most remarkable circumstance connected with its influence on the brain, is the exemption of those who have experienced its excitant effects from the subsequent depression, which, as an almost universal rule, follows stimulation. I know no other explanation which can be offered of this peculiarity, than that, in consequence of its chemical nature, the exhaustion of the cerebral cells through the over-excitement it produces, is immediately repaired by the nutritive material, oxygen and nitrogen, which it offers to them; the carbonaceous and hydrogenous matter being always ready in the blood. Besides its general stimulating effects, nitrous oxide is said to have decided aphrodisiac properties, similar to those sometimes exhibited under the influence of ether.

Besides the exhilarating powers of nitrous oxide, Davy also discovered its anæsthetic property, and even advanced so far as to suggest that advantage might be taken of this property in obviating the pain of surgical operations. But no practical advantage was taken of this suggestion until the year 1844, when Dr. Horace Wells, of Connecticut, who had been thinking of the means of rendering surgical operations painless, and especially the extraction of the teeth, having become acquainted with the anæsthetic property of nitrous oxide, immediately turned his knowledge to account by trying an experiment on himself. Having occasion for the extraction of a tooth in his own person, he put himself under the influence of nitrous oxide, while the operation for extraction was performed, and was happy to find that the operation was entirely painless. Soon afterward, as the result of his experiment, two important surgical operations were performed, one by Dr. Marcy, and the other by Dr. Ellsworth, of Waterford, Connecticut, both of which confirmed the expectations of Dr. Wells. (*Med. and Surg. Reporter*, Feb. 10, 1866, p. 117.) For sixteen or eighteen years after this, the subject of nitrous oxide inhalation seems to have been forgotten by the profession, probably under the excitement of the ether and chloroform discoveries, until revived by Mr. G. L. Colton, of New York, in its application to dentistry, and by Dr. J. M. Carnochan, of the same place, in its application to higher surgery. In the former respect, it has now come into extensive use; and thousands, if not tens of thousands, every year experience its benefits. In surgery, too, it is slowly making its way, but is as yet far from having superseded ether and chloroform. There are some objections to it as an anæsthetic in the more serious surgical operations which are not applicable to dentistry. Though very speedily induced, its anæsthetic effect is as quickly over; so that, to maintain the insensibility long enough for most of the serious operations, it is necessary frequently to renew the inhalation; and as, in the case of nitrous oxide, this requires the co-operation of the patient, it can readily be perceived that there must generally be considerable difficulty, and sometimes an impossibility of sustaining the anæsthetic action of the medicine a sufficient length of time. One great advantage, however, which the nitrous oxide has over all the other known anæsthetics is, that it is itself a supporter of respiration, so that a temporary exclusion of the atmospheric air from the lungs would not endanger asphyxia, while its place was supplied by the nitrous oxide. The period at which the anæsthetic effect takes place after the administration of nitrous oxide, varies exceedingly. It may take place in a minute or two, or not till a great deal longer; much depending upon the depth of the inhalation. One writer states that he has known anæsthesia to come on after only three deep and slow inhalations; while the process is often prolonged to twenty inhalations, in cases of superficial breathing from compressed or diseased lungs. (*Bost. Med. and Surg. Journ*, Sept. 7, 1865, p. 118.) The duration of the insensibility is short, generally, perhaps, not much exceeding the time required for inducing it.

The use of nitrous oxide as an anæsthetic in surgery is gradually spreading. It has been employed in Philadelphia in several of the higher surgical operations; but the general conclusion thus far obtained is, I believe, that it is more especially adapted to dentistry, and to surgical operations which require little time; but that for the more protracted cases ether is preferable. The insensibility to pain is quite as complete, while it lasts, as that caused by the other anæsthetics; and the only objection, therefore, is its brevity. When some method shall be contrived for continuing the effect, without the instrumentality of the patient, there is no reason, so far as is now known, why the nitrous oxide should not supersede all others; being in its administration much less unpleasant than ether, in its effects vastly less dangerous than chloroform, and in its after-effects less disagreeable than either of the others, both of which are not unfrequently followed by nausea and depression.

The danger from inhalation of nitrous oxide, when managed with due caution, may be considered as absolutely nothing. Of course if used in cases not adapted to it, harm may result as from any other remedy. If, for example, it were to be applied in cases of active congestion of the brain, acute inflammation, and general plethora, it would be likely to prove injurious, like alcoholic remedies under the same circumstances. But with ordinary caution in this respect, and care to use only a perfectly pure article, there is really no danger, unless from the existence of some latent predisposition, which might be called into action by this as by any other medicine. In a single dental establishment, out of 4,000 cases in which it was used, not the least injury resulted in a single case. (*Boston Med. and Surg. Journ.*, Sept. 29, 1864.)

Nor is it simply as an anæsthetic that nitrous oxide is likely to be employed. Its conjoined powers of general stimulation especially directed to the cerebral centres, and of directly oxidizing the blood, render it applicable to a great number of diseases, in which life is endangered by general prostration, loss of brain power, and insufficiently oxidized blood. The collapsed condition of cholera; the vast prostration of the pernicious chill; the cold stage of all other fevers in which reaction is feeble or insufficient, as in malignant cases of typhus, yellow fever, diphtheria, scarlet fever, erysipelas, etc.; the debilitated states of these same fevers, and of others, as enteric for example, in their course, or towards their close; cases of positive or threatened asphyxia, from strangulation, drowning, cold, and narcotic poisons; all these afford decided indications for this remedy, to which the only objection, in such cases, is the inconvenience of its administration. Hitherto the remedy has made little headway in this direction; but in an interesting report of Dr. Geo. G. Shumard, Medical Director in the U. S. Army, an account is given of eight cases of disease, of the character above mentioned, which were considered hopeless under any ordinary treatment, in which the inhalation of this gas, even under circumstances not the most favourable for its effective exhibition, was followed in all by decided signs of improvement, and in three was believed to have saved life. (*Boston Med. and Surg. Journ.*, Jan. 18, 1863, p. 446)

Mode of Exhibition. The ordinary method of administration is by means of an air-tight bladder, with a tube and mouth-piece attached, through which the patient breathes, inhaling the contents of the bag, and returning into it the air from the lungs; the nostrils being closed during the process. Though the effects of the gas may be obtained in this way, yet it is liable to the objection, that the same air is constantly breathed over again; and, as the carbonic acid from the lungs is steadily increasing, and the nitrous oxide as steadily diminishing, it must happen at length, if the process be long continued, that the air breathed will be chiefly the former gas, and asphyxia may be endangered from this cause. To obviate the chance of this evil, the bag should be large enough to hold all the gas required to produce the anæsthetic effect; and, instead of one or two gallons, which is often its capacity, should contain several gallons, not less, according to Dr. Spears, than six or eight, though this would probably, in general, be considered unnecessarily large. (*Med. and Surg. Reporter*, Feb. 10, 1866, p. 118.) But a still better plan is to use a bag with a valve in the tube opening outward, so as to permit the entrance of the air of the bag into the lungs, but to prevent the return of the expired air into it. When the operation is carried on very largely, as in the office of a dentist, it will be convenient, in order to ensure at once a sufficient supply of the pure gas always on hand, and the greatest convenience of administration, to be provided with an apparatus both for the preparation and preservation of the gas; including the retort with the means of heating it, several bottles containing the purifying liquids through which the gas is to pass successively, and a large reservoir or gasometer of zinc, which may receive the gas as generated, and retain it for use. With this gasometer a tube may be connected, furnished with a valve opening outward, through which the patient may inhale the gas without returning a particle to the reservoir.*

Nitrous Oxide Water. The aqueous solution of the gas without pressure, containing from three-quarters to an equal bulk of the gas, was tried internally by Sir. H. Davy, who believed it to promote digestion, and to act as a diuretic. An oversaturated solution made under pressure, and containing five volumes of the gas for one of water, was patented in England, where it was known as *Searle's oxygenous aërated water*, and has been used to some extent as an internal remedy. By Sérullas it was thought to be useful in Asiatic cholera. In this country, the internal use of nitrous oxide water has been especially investigated by Dr. Geo. J. Ziegler, of Philadelphia, who made various experiments both on the human subject and the lower animals, and published the results of his researches. The solution taken into the stomach, or injected into the bowels, appears to exercise in some degree the stimulant and exhilarating effects of the gas inhaled, at the same time that it produces a gently excitant effect on the mucous membrane, and by absorption to improve the blood, when deficiently oxygenated. Among other effects which it has in common with the inhaled gas, is that of obviating asphyxia from various causes, by at the same time oxidizing the blood and stimulating the nervous centres and the heart. The diseases in which the nitrous oxide water has been employed, with supposed advantage, or may be used with hope of benefit, are dyspepsia; depression of spirits; general torpor and debility; neuralgia connected with debility; gastralgia; asthma; syncope; threatened or existing asphyxia; the debility following the excitement of the stimulating narcotics, as opium, alcohol, ether, etc., and that attending the immediate action of the cerebral or nervous sedatives, as chloroform, hydrocyanic acid, digitalis, tobacco, aconite, etc.; and, finally, the low condition of all fevers requiring stimulation, in which this remedy is particularly indicated, as not being followed by depression. Dr. Chapelle, of Angoulême, in France, has found the remedy especially beneficial in lypemania, or that form of monomania in which the delusion is attended with depression of spirits or melancholy. (*Arch. Gén.*, Juin, 1865, p. 739.) According to the observations of Dr. Ziegler, its long-continued use occasions emaciation, resulting from the too rapid oxidation and consequent excess of the vital changes of the tissues; but this condition is much less serious than that proceeding from an opposite cause, as it indicates no depreciation of the vital powers. Indeed, the remedy may be used, in case of morbid obesity, with a view to this very effect.

---

* For an account, with a figure, of an apparatus, contrived by Prof. Vander Weyde, and described by Dr. Sam. W. Francis, of New York, see the *Medical and Surgical Reporter* (May 19, 1866, p. 382).

Where it cannot be taken by the mouth, it may be administered with similar results by the rectum. From half a pint to a pint and a half of the nitrous oxide water may be taken, in wineglassful doses, less or more, through the day. Three times the quantity may be given by enema.

Peroxide of Hydrogen. Some attention has recently been attracted to peroxide of hydrogen as an oxidizing agent in the system, and as a remedy of diversified powers, by the experiments and researches of Dr. Richardson, of London; but it has not yet practically obtained such a position in therapeutics, as to authorize its adoption into the catalogue of remedies. Further trials may justify, or perhaps even exceed the hopes entertained in relation to it. At present I must content myself with referring to the *U. S. Dispensatory* (12th ed., p. 1579), where an abstract will be found of all that is at present known concerning it in a remediate capacity.

IV. CAMPHOR.

CAMPHORA. *U. S., Br.*

Origin. Camphor is a concrete substance obtained from *Camphora officinarum*, an evergreen tree, of considerable size, growing in China and Japan, and other neighbouring countries, and occasionally kept in conservatories in temperate latitudes. The whole plant is impregnated with the camphor, which is separated either by sublimation, or by boiling, and, in the latter case, is sublimed before being sent into market. It comes to us either from the ports of China, or indirectly from Japan through Dutch commerce. As imported, it is not sufficiently pure for use, and is, therefore, submitted to another sublimation, along with a small proportion of quicklime. Thus prepared, it is in large circular cakes, an inch or two in thickness, slightly convex on one side and concave on the other, and perforated in the centre.

Properties. As kept in the shops, camphor is usually in fragments of the cakes above mentioned, usually somewhat whitish on the surface, but beautifully clear and translucent within. It has a strong, fragrant, characteristic odour, and a warm, pungent, somewhat bitter taste, which leaves a sense of coolness in the mouth, especially perceptible when the air passes over the tongue during inhalation. It is somewhat unctuous to the touch, and very brittle, yet of difficult pulverization, in consequence of a certain tenacity in its constituent granules, which causes them to flatten under the pestle, without breaking into powder. It may, however, be readily reduced to powder, by first adding a little alcohol, by grating and sifting, or by precipitation by water from its alcoholic solution. Camphor is lighter than water, and, when thrown upon it in small fragments, floats on the surface, and performs various gyratory movements, probably in consequence of the repulsion of its vapour. It is highly volatile, and if exposed to the air will in time wholly disappear. At a temperature somewhat above that of boiling water, it melts, at a higher temperature boils, and at a still higher takes fire, burning with a brilliant flame, but much smoke, and leaving no residue. In close vessels it may be sublimed unchanged. It is very slightly soluble in water, which, by simple agitation with it, takes up one-thousandth of its weight, and acquires the smell and taste of the camphor. By the intervention of an agent which enables it to be very minutely divided, as magnesia or its carbonate, it may be dissolved in water in much larger proportion. It is very soluble in alcohol, extremely so in chloroform, and to a considerable extent also in ether, the volatile and fixed oils, strong acetic acid, and the diluted mineral acids; even carbonic acid water dissolving it more largely than water itself. When rubbed with resinous substances, it often loses a part of its odour, becomes softened, and is thus rendered more readily suspensible in water.

Composition. Camphor consists of carbon, hydrogen, and oxygen, which are thought to be combined in the form of oxide of *camphene*, a compound radical consisting of 10 equivalents of oxygen and 8 of hydrogen, and supposed to be identical with pure oil of turpentine.

Another variety of camphor, denominated *Borneo*, or *Sumatra*, or *Dryobalanops* camphor, is obtained from the interstices of the wood of *Dryobalanops Camphora*, a large forest tree of Sumatra and Borneo. It is never, however, imported for use into America or Europe.

1. EFFECTS ON THE SYSTEM.—Opinions the most opposite, and facts apparently the most contradictory, have been published in relation to the mode of operation and effects of camphor. Some consider it essentially sedative in its action, whether on the circulatory or nervous system; while others with equal positiveness determine that it is stimulant; and others again think that it may be the one or the other; and facts not to be denied are adduced in support of each opinion. In the present state of our experimental knowledge on the subject, it is impossible to decide with certainty between these conflicting views and statements. More numerous observations, made under every variety of circumstances, and without influence from preconceived opinions, are necessary before any view of its mode of operation can be received as demonstrated. Nevertheless, it may be possible to find some clue through the labyrinth of seeming contradictions; and, after giving a succinct account of the effects produced by camphor, as deduced from the great multitude of published facts, and from my own personal observation, I shall endeavour to explain them, as far as practicable, in accordance with the general principles maintained in this work.

Local Effects. In the first place, when applied locally, and confined so as to prevent evaporation, camphor produces heat, more or less redness, and not unfrequently pain. These effects are not very obvious upon the skin protected by the cuticle; but, when the medicine is applied in concentrated solution, they will, I think, be found to take place in some degree. In blistered and ulcerated surfaces, and in the mouth, they are incontestable. MM. Trousseau and Pidoux state, as the result of personal experiment, that pieces of camphor, held in the mouth for half an hour, had, at the end of that time, produced redness, heat, and painful swelling in the part with which they were in contact. (*Mat. Med.*, 4e ed., ii. 235.) The experiments of Orfila on animals prove that the same effect is produced in the gastric mucous membrane. When camphor was given in small fragments, it was found, after the death of the animal, to have caused inflammation, and numerous small points of ulceration. It is well known that, in man, when swallowed in the form of pill, it is apt to occasion uneasiness or pain in the stomach, and, if in considerable quantities, even nausea and vomiting. It would seem, therefore, that camphor is a local stimulant. But how are we to account for the coldness felt in the mouth when it is swallowed, and, as some assert, even in the stomach? Simply by its volatility. In its conversion from the solid state to that of vapour, it necessarily absorbs heat, and produces the sensation of cold; and this is especially observed when the air is drawn through the mouth, thus favouring the evaporation. There can be no doubt that the same change goes on to some extent in the stomach, under the higher temperature to which the camphor is there exposed, and a necessary result there also is the production of more or less coolness. But excitement of the part is probably not the only effect of camphor. It is scarcely possible that the medicine should have been adhered to, as a local anodyne in rheumatism and other painful diseases, so universally, so pertinaciously, and through so long a series of years, if it really possessed no power of this kind. But nothing is more common, in our experience of the operation of medicines, than the succession of a stimulant and sedative effect. Chloroform powerfully irritates a surface for a time, and afterwards as powerfully reduces its sensibility to painful impressions. Camphor operates in the same way; but, whether its sedative effect on the nervous extremities is direct, or consequent upon a previous stimulant effect upon them, there are no facts which enable us to determine. The question may perhaps be, in some degree, analogically settled, if we can determine how the medicine acts upon the nervous centres; for it is probable, though by no means certain, that it acts upon the same principle in both positions.

General Effects. Our attention is next to be directed to the effects of camphor on the system at large. Omitting the impression it may produce on the stomach, which will vary with the predominance of the refrigerant influence of the evaporation, or the direct excitant influence of the camphor, and with the mode of its exhibition, whether in solution, finely divided, or in mass, I shall notice only the constitutional effects. From a very small dose, sufficient, however, to make a decided impression in certain morbid states of the system, no sensible effect whatever is experienced in health. A somewhat larger dose will usually be followed by a slight increase in the frequency and perhaps fulness of the pulse, and in the warmth of the surface, and occasionally by some diaphoresis. In the course of about twenty minutes, there may be a slight exhilaration of spirits, or feeling of comfort induced, which, however, is much more observable in depression or uneasiness from nervous disorder than in health. This passes over in a short time, and no other discoverable effect may be produced. Thus far the medicine operates in exact accordance with the class of nervous stimulants. A larger dose will occasion obvious narcotic symptoms. With or without preliminary excitement of the circulation, there will now be a feeling of giddiness, perhaps also of languor or lassitude, with more or less mental confusion or unsteadiness; and, if the impression be very decided, there may also be some disorder in vision and hearing. These symptoms are soon followed by heaviness, mental hebetude, and a disposition to sleep; during which the general sensibility is impaired, the pulse, whether at first excited or not, usually becomes slower, though perhaps still full, and the temperature of the surface is somewhat lowered.

Very opposite statements have been made, in reference to the effects of the medicine upon the urinary and genital organs, by persons who equally speak from their own experience, and, so far as can be determined, are equally deserving of confidence. While, according to one statement, camphor is apt to irritate the urinary passages and the organs of generation, producing even strangury in the one, and sensations of voluptuous excitement in reference to the other, the opposite statement affirms that the medicine, instead of causing, is admirably adapted to relieve strangury, and is a powerful antaphrodisiac, producing excellent effects in priapism, nymphomania, a disposition to onanism, etc. Now these assertions are not so contradictory as they seem. Allowing the camphor to act upon the nervous centres as a stimulant, the first stage of its action may be an excitation of the function over which the centres respectively preside, while, in the second stage, the congestion of the centre shall be such as to impair its power, and consequently depress the dependent function. Thus, camphor may excite, and may depress the generative organs, and whether it will do the one or the other, may depend upon the stage of its action, as well as on the quantity given, and on various circumstances which may hasten or retard, increase or diminish its influence. If it act promptly and powerfully on the centre, the first stage of excitation may pass over so rapidly that only the succeeding sedative effect may be felt; if, on the contrary, less rapidly and less powerfully, its congestive effect in the centre may not pass the boundary of pure excitation, and the function be stimulated accordingly. The different effects on the urinary passages may be explained on the same principles; or we may suppose that, in producing one effect, the camphor may act through the system, and, in producing the other, locally.

Poisonous Effects. In great excess, camphor sometimes occasions nausea and vomiting, by which it is discharged, and ill effects averted. If not speedily thrown off from the stomach, it gives rise to anxiety, vertigo, disordered or obtunded hearing and vision, delirium, insensibility, muscular twitchings, convulsions, and deep stupor. Along with these symptoms there are usually diminution in the frequency and force of the pulse, paleness of the face, and coolness of the skin, which is sometimes bathed in cold sweat. The symptoms come on usually in less than half an hour, increase gradually in intensity, and in the course of an hour or two end in unconsciousness. If the poison is evacuated, they will go off quickly; otherwise, they may continue several hours, and gradually decline, the patient returning to consciousness, but with some confusion of mind and feebleness of memory remaining for a longer or shorter time. Except in the case of an infant, of about eighteen months, who died from the effects of the poison, after taking about ten grains, no instance of fatal result is on record; but in many instances the symptoms have been very alarming, and quite sufficient to suggest caution in the use of large doses. It is a singular fact that, in some of these cases of poisoning, there have been at first evidences of high circulatory excitement, with flushed face, and other symptoms of determination of blood to the head, followed by a state of depression; while in other cases the depressed condition has first occurred, and the symptoms of excitement, amounting even to fever, have followed. It has been attempted to explain the latter by the reaction following depression; but we do not see the same phenomena succeeding the prostrating influence of real direct sedatives, such as conium, chloroform, digitalis, hydrocyanic acid, etc. It is more probable that they were the result of the direct action of the poison on the brain; and the different states of excitement and prostration were probably merely the results of different degrees of excitant or irritant influence on the cerebral centres, in one instance being only sufficient to stimulate them to excessive action, in the other overwhelming them with an active congestion, and thus preventing their due influence on the functions over which they preside, whether of the heart, lungs, or special senses. The occurrence of febrile symptoms, and obvious cerebral excitement, after the depressing effects have been for some time experienced, may be owing to a subsidence of the active congestion of the cerebral centres to a point, at which their operations are unembarrassed, and at which, consequently, they are enabled to extend the direct effects of their irritation throughout the system. If any physician will ask himself the question, whether he would venture to give camphor, in large doses, in acute inflammation or active congestion of the brain, he will at least determine what is his own real belief of its action. If he agree with the author in thinking that it could do only injury under such circumstances, he will be disposed to rank camphor, as is here done, among the cerebral stimulants. Until he is prepared to administer it as an effectual remedy in such cases, he cannot be thoroughly convinced of its direct sedative properties.

The quantity in which camphor is capable of producing poisonous effects varies exceedingly, according to individual peculiarity, or to circumstances not well understood. Thus, while Mr. Alexander, of Edinburgh, suffered the most threatening symptoms, including convulsions and stupor, from forty grains, and even twenty grains have produced alarming effects, more than two drachms have been taken without serious consequences. The ten grains which proved fatal in the child of eighteen months, are probably equivalent to eight or ten times as much given to an adult.

The main remedy in poisoning from camphor is to evacuate the stomach. The after treatment depends altogether on the symptoms presented; but, in general, little else is required.

2. MODE OF OPERATION.—Camphor probably acts on the system at large exclusively through the blood. That it is absorbed is proved by its odour in the breath and perspiration, and, as some have asserted, in the urine, and by the result of an experiment of Tiedemann and Gmelin, who distinctly perceived the smell of camphor in the portal blood of a horse, to which the drug had been given.

From what has been stated above, it has been already inferred that I consider camphor as directly stimulant, both locally and generally, with very little comparative influence on the circulation, but a powerful action in large doses on the brain, and as indirectly sedative to all the functions, including of course that of the heart, through the over-stimulation or congestion of the nervous centres.

3. THERAPEUTIC APPLICATION.—Camphor was probably unknown to the ancient Greek and Roman physicians, and was introduced into Europe by the Arabians. In small doses of from one to three grains, repeated at short intervals if required, it often answers an admirable purpose as a nervous stimulant, relieving slight pains, vague uneasiness, nervous headaches, muscular twitchings, restlessness, jactitation, etc., and often enabling the patient to sleep by removing the causes which keep him awake. It is much used for this purpose in various diseases, generally in the state of camphor water, or combined with opium in the officinal *camphorated tincture of opium*, or paregoric.

In a full dose, calculated to act as a cerebral stimulant, it may be employed to stimulate the brain in a depressed state of its functions, to relieve pain, and to allay spasm and other nervous disorder. It probably produces the two latter effects by rendering the cerebral centres, through its congestive influence upon them, insensible to the impressions sent from the affected part, and incapable of transmitting influence to the muscular or other dependent function.

The following are the special diseases in which it has been most employed; but, whatever may be the name of the affection in which the indications above mentioned may be presented, it may be used to meet them, provided no contraindication exist.

Idiopathic Fevers. Whenever, in any one of these complaints, whatever may be the particular character of the fever, there may be general uneasiness, restlessness, jactitation, tremors, twitchings or startings of the muscles, slight delirium, wakefulness, etc., and these symptoms may be in no degree dependent on, or connected with active congestion or inflammation of the brain, camphor may be employed as a nervous stimulant, and will often be found to act most happily in relieving them. The most convenient form for using it, under these circumstances, is that of the *camphor water* of the U. S. Pharmacopœia, of which one or two tablespoonfuls may be given every hour or two, until the desired effect is produced. The symptoms referred to are peculiarly apt to occur in children, for whom, according to the age, the dose may vary from thirty minims to one or two fluidrachms, at the same intervals. Advantage will often accrue from combining or alternating it with compound spirit of ether (Hoffmann's anodyne), or with spirit of nitric ether (sweet spirit of nitre), under the same circumstances, and sometimes with one of the liquid preparations of opium, when that medicine may be simultaneously indicated.

In *enteric* and *typhus fevers*, and in the *low typhoid state of febrile diseases generally*, camphor is particularly indicated; and may sometimes be employed with benefit, not only for the purposes above mentioned, but also as a cerebral stimulant, in aid of wine-whey, carbonate of ammonia, etc., when the pulse is frequent and feeble, the tongue and skin dry, and the patient affected with low muttering delirium. The supposed diaphoretic property of the medicine comes here in aid of its stimulant action on the brain, which is in a depressed condition under the sedative influence of the depraved blood, or directly of some absorbed poison.

Inflammation. Under the impression of its sedative powers, camphor has been recommended strongly in inflammatory diseases generally, and especially in acute rheumatism, in which it has been supposed to exercise peculiarly beneficial powers. Of course it may be used in these complaints when the nervous symptoms above referred to call for it; but it is not in this capacity that its employment is now alluded to. It is supposed, in these complaints, to exercise a directly sedative influence over the inflammatory excitement, at the same time favouring perspiration. I have no doubt that it may act beneficially, but not precisely in the manner supposed. Whatever sedative influence it may exert is, I believe, secondary, and dependent on a direct stimulation and consequent congestion of the cerebral centres; and the inference from this view is, that it should not be employed in acute cerebral inflammation, or active cerebral congestion; nor, indeed, in any other inflammation with a full strong pulse and sthenic state of system, until the vascular fulness and excitement have been subdued by depletory measures. In other words, I think that it acts upon the same principles precisely as opium in these cases, and, like it, should be associated with medicines calculated to give it a direction to the skin, and obviate any stimulation it may produce, such as tartar emetic, the neutral mixture, nitre, etc. It is probably the similarity and, at the same time, inferiority of its action to that of opium, that has led to its disuse in inflammations; and advantage might sometimes accrue, particularly in inflammatory rheumatism, from having recourse to it as a substitute for opium, when that medicine, from its peculiar properties, may act in some way disadvantageously. When on the subject of opium, I shall more fully discuss its mode of operation in inflammations; and what may be said there will apply in considerable degree to camphor. With a view to its antiphlogistic effects, it must be used in full doses.

Painful Affections. Camphor has been occasionally used as an anodyne in *neuralgia*, but is much less efficient than several other medicines belonging to the class. In *nervous headaches* it may be useful, when they depend on cerebral depression; and, in slight cases, when the headache is merely an expression of some trivial nervous disorder, a small dose of camphor, with a little opium, as in the common paregoric elixir, will often operate happily. It is, however, in *dysmenorrhœa* that camphor has been most used merely as an anodyne. To fulfil this indication it must be given in the largest doses.

Spasmodic and other Nervous Disorders. In the more violent of the painful spasms, the anodyne and relaxing powers of camphor, in any ordinary dose, are quite inadequate to the results desired. It is of little use, therefore, in spasm of the stomach, ureters, or bile-ducts, in the severe forms of colic, in tetanus, etc.; yet it has been employed, with supposed advantage, in the violent cramps attendant upon *poisoning* by *strychnia;* and, in conjunction with opium, is occasionally used in epidemic cholera, and, in small doses, in the diarrhœa or cholerine preliminary to that disease. In the convulsive affections produced through the cerebral centres, it has sometimes been employed with great asserted benefit, particularly in *puerperal convulsions;* but, having no personal experience of it in this affection, I do not feel at liberty to recommend it. It has been used also in *epilepsy, chorea*, and *hysterical convulsions* with occasional advantage; but cannot be depended on for more than temporary relief, and often fails to produce that. In *pertussis*, and other instances of *spasmodic cough*, it may be given as an adjuvant to more efficient medicines; but is little used. In the *cough* attendant upon *inflammatory affections* of the chest, in their *advanced stages* and *chronic forms*, it may sometimes be usefully associated with expectorants, when opium may be contraindicated, or in connection with that narcotic. In the form of *camphorated tincture of opium*, it very often enters into *cough mixtures* under the circumstances mentioned; but, in this form, should not be employed in the earlier stages. In the various slighter nervous disorders of *hysteria*, of the *puerperal state*, of *hypochondriasis*, of feeble *paralytic cases*, and of *chronic debility* in general, it may be used with occasional benefit, in small doses, as a nervous stimulant, either alone, or associated with other medicines.

It has been much used by some practitioners in *insanity* to produce sleep and quiet irritation; and may be considered as indicated in that complaint under similar circumstances with opium, to which, however, it is greatly inferior. It has been particularly recommended in melancholy. In occasional attacks of apparently causeless *mental depression*, it sometimes acts very happily.

From its stimulant influence on the nervous centres, it has been used in cases of *amaurosis*, of a purely functional character, with asserted success; but it has, under these circumstances, generally been prescribed with other medicines, such as valerian, arnica, etc.

It has been used in *delirium tremens* to aid in procuring sleep, as well as in quieting the varied nervous disorders of that affection; but, if used at all, it should be merely as an adjuvant of opium, or in conjunction with other narcotics when opium cannot be used.

One of the applications of camphor about which there has been the greatest difference of opinion, is to the alleviation of irritations of the urino-genital apparatus. The testimony, however, in favour of its occasional efficiency in morbid sexual excitement is too strong to be rejected. Sometimes in small, and sometimes in large doses, it has been given, with at least temporary advantage, in cases of *nymphomania, priapism*, and uncontrollable venereal propensities exhibited in other forms. Alone, or associated with lactucarium or lupulin, it may always be given in such affections with hope of benefit.

Many employ it habitually to prevent or relieve strangury from Spanish flies used for blistering. For this purpose it is sprinkled on the surface of the plaster before application, and is given internally to relieve the affection when produced. I have never, however, found any very satisfactory influence from it, in the doses in which I have been willing to employ it; but have no doubt that, in large doses, whether by the mouth or rectum, it would sometimes have the desired effect; but the relief obtained, under such circumstances, by an anodyne enema of laudanum is so prompt and certain, that I have seldom thought it worth while to resort to less efficient means.

Camphor has also been employed in the *retrocession of cutaneous eruptions*, in order to relieve internal irritation by its calming influence, and to favour the return of the eruption by its diaphoretic action.

Contraindications. It is scarcely necessary to repeat that camphor should not be given during the existence of active vascular irritation, congestion, or inflammation of the brain, nor in high febrile excitement with a strong pulse and sthenic state of system; and that, in any case presenting these conditions, whatever otherwise may be the indication for its use, they should be subdued before it can with propriety be prescribed. Nor should it be administered when the stomach is inflamed.

Local Use of Camphor. Few medicines are more frequently employed topically than camphor. In the *form of vapour*, it is sometimes inhaled in *asthma*, *spasmodic coughs*, and *chronic catarrhal affections*; and there is no doubt that its constitutional impression may be obtained in the same way. It may be applied by means of an ordinary inhaler, placed in water more or less heated to favour the volatilization of the camphor. M. Raspail recommends that a small tube, a quill for example, should be filled with the coarsely powdered medicine, and loosely closed at each end so as to admit the passage of air, and that this should be used in the same manner as a cigar, but without burning. In the inhalation of camphor, care must be taken to arrest the process, when signs are exhibited of its acting on the brain.

Another mode of using the vapours of camphor is in the form of *a vapour bath*. For this purpose the patient may be seated naked on a stool, and covered with a blanket closely applied about his neck, and hanging down around him upon the floor. A plate of heated metal, holding half an ounce of camphor, should then be placed underneath the blanket, so that the vapours may completely surround the body. A similar arrangement may be made, by means of crossed hoops and the bedclothes, about the patient in bed, if unable to rise. The vapour thus applied is highly recommended by M. Dupasquier, in *chronic rheumatism*.

A piece of camphor held before the nostrils, so that its vapour may be snuffed up into the nasal passages, is sometimes beneficial in *coryza*. *Powdered camphor* has been recommended to be used in the same way, and for the same purpose, as well as for the relief of various spasmodic and catarrhal affections of the air-passages.

Dissolved in different liquids, camphor is injected into the *urethra*, *vagina*, and *rectum*, for the purpose of relieving irritations of those passages, and is very much used as an application to the surface, chiefly with a view to its anodyne effect, in various painful affections, as *gout*, *rheumatism*, *neuralgic pains*, *sprains*, *bruises*, *chilblains*, etc. It is also used as a stimulant to *gangrenous*, *flabby*, and *indolent ulcers*.

In the solid state, also, camphor is sometimes employed externally. Allusion has already been made to the use of the powder in the form of snuff, for which purpose it should be made very fine. In a similar state, it may be applied in cataplasms to painful parts; and half a drachm of it, thus applied to the perineum, will sometimes relieve the chordee attendant on gonorrhœa.

ADMINISTRATION.—Camphor may be used in pill or emulsion, but the latter form is greatly to be preferred; as, in the former, it is more apt to irritate the stomach, probably by floating upon the gastric liquids, and thus coming in a concentrated state into contact with the mucous coat. The emulsion may be made by first pulverizing the camphor with a few drops of alcohol, and then rubbing it up with powdered gum arabic, loaf-sugar, and water, to which a little myrrh may be added, in order to favour the suspension of the camphor. Another mode of preparing the emulsion is first to dissolve the camphor in a little chloroform (see *Chloroform*), and then to incorporate the solution, by means of the yolk of an egg, with water. The medicine may also be given suspended in milk; but an objection to this is its liability to undergo change in a short time. The officinal aqueous solution, and the tincture, are convenient forms for administration.

The dose of camphor varies from one to twenty grains. As a simple nervous stimulant, it may be given in the dose of from one to three grains, repeated every hour or two, if required. For its full effect as a cerebral stimulant, or indirect sedative, the medium dose is from five to fifteen grains. When a powerful effect is required, as in certain painful neuralgic or spasmodic affections, the dose may be increased to a scruple. By enema, it may be given in twice or three times these quantities.

The following preparations of camphor are officinal.

1. CAMPHOR WATER.—AQUA CAMPHORÆ. *U. S., Br.*

This is made, according to the U. S. Pharmacopœia, by rubbing two drachms of camphor, first with forty minims of alcohol, afterwards with four drachms of carbonate of magnesia, and lastly with two pints of distilled water, and then filtering. The camphor is thus dissolved in water much more largely than by simple agitation. The carbonate of magnesia merely serves the purpose of dividing its particles minutely. Each fluidounce of the preparation, when well made, contains about three grains of camphor. The British preparation, which is made by exposing camphor, enclosed in a muslin bag, to the solvent power of water in a jar, is much feebler, and probably never used with us. Camphor water is an elegant preparation for obtaining the slighter effects of camphor as a nervous stimulant, in the nervous disorders of febrile diseases, slight hysterical affections, uterine after-pains, etc. It also frequently serves as a good vehicle of other medicines in bowel complaints, especially of nitric and nitromuriatic acids. It is not adapted for obtaining the more powerful effects of camphor. The dose of it is one or two tablespoonfuls every hour or two. It was a favourite application of Scudamore in acute gout, mixed with alcohol, in the proportion of three parts of the former to one of the latter. The mixture was applied to the inflamed joint on linen compresses of six or eight folds, or by means of bread poultices saturated with it.

2. SPIRIT OF CAMPHOR.—SPIRITUS CAMPHORÆ. *U. S., Br.*—TINCTURA CAMPHORÆ. *U. S.* 1850.—*Tincture of Camphor.*

This is simply a solution of camphor in officinal alcohol. A fluidrachm of it contains seven and a half grains. It is chiefly used externally, as an anodyne embrocation in rheumatic and gouty pains, chilblains, sprains, bruises, etc. I have sometimes used it mixed with five or six parts of milk, and applied on linen compresses, as an anodyne and emollient in acute gout. It is also frequently employed in nervous disorders, as lassitude, faintness, and slight hysterical affections, applied to the forehead, cheeks, etc., and held to the nostrils, so that its vapour may be inhaled. The tincture may also be used internally, whenever the alcoholic vehicle may not be contraindicated. The camphor is precipitated by water, but may be held in suspension by sugar or gum. The dose is from ten drops to a fluidrachm, first dropped upon loaf-sugar, and then mixed with water.

3. CAMPHOR LINIMENT.—LINIMENTUM CAMPHORÆ. *U. S.*, *Br.*

This is a solution of camphor in olive oil, half an ounce of the former being employed to two fluidounces of the latter. It is used locally for the same purposes as the spirit, and as a discutient application to glandular swellings. It may also be used as an injection into the rectum in the tenesmus of ascarides and dysentery, and into the urethra for the relief of the ardor urinæ of gonorrhœa. As an enema, not more than one or two fluidrachms of it should be thrown into the rectum at once, diluted with from two to four fluidounces of olive oil; and a preparation of the same strength may be used for the urethra.

The *British Pharmacopœia* directs a *Compound Camphor Liniment* (LINIMENTUM CAMPHORÆ COMPOSITUM,) consisting of camphor, solution of ammonia, and spirit of lavender; but such mixtures might well be left to extemporaneous prescription. It is in fact a spirit of camphor, rendered more stimulating by the ammonia, and intended, therefore, to act both as a rubefacient and anodyne. It is employed externally for the same purposes as the tincture.

4. CAMPHORATED TINCTURE OF OPIUM.—TINCTURA OPII CAMPHORATA. *U. S.*—*Paregoric.*

This tincture will be treated of among the preparations of opium, to which the reader is referred.

5. SOAP LINIMENT.—LINIMENTUM SAPONIS. *U. S.*, *Br.*—TINCTURA SAPONIS CAMPHORATA. *U. S.* 1850.—*Camphorated Tincture of Soap.*

This consists of Castile soap, camphor, and oil of rosemary, dissolved in alcohol diluted with one-eighth of its measure of water. It is a clear liquid, and is very much used as an anodyne and gently rubefacient liniment, in all the outward pains for which camphor is locally employed. (See *pages* 704–5.) To render it more anodyne, it may be mixed with an equal measure of laudanum, constituting the *Anodyne Liniment* or LINIMENTUM OPII of the British Pharmacopœia; and, if stronger rubefacient properties are required, stronger solution of ammonia may be incorporated with it in the proportion of one-fourth by measure. The latter preparation may be used as an effective rubefacient in pectoral inflammation, angina, laryngitis, and tonsillitis.

6. CAMPHORATED SOAP LINIMENT.—LINIMENTUM SAPONIS CAMPHORATUM. *U. S.* 1850.—*Opodeldoc.*

The camphorated soap liniment is essentially the same as the soap liniment just described, differing in the kind of soap employed, which in this preparation is the common white soap, made with animal fat, instead of the Castile soap, made with olive oil. The effect of the substitution is that the liniment is obtained of the consistence of a jelly, in consequence of the hot alcoholic solution of common soap gelatinizing when it cools. It is usually sold in broad-mouthed bottles, containing about four fluidounces. Though of the consistence of a soft solid at ordinary temperatures, it assumes the liquid state when applied to the surface of the body. It is much used popularly, under the name of *opodeldoc*, in rheumatic pains, bruises, sprains, etc. It was, however, discarded from the U. S. Pharmacopœia at the late revision.

V. OPIUM. *U. S., Br.*

This is a concrete juice obtained by incisions in the unripe capsules of *Papaver somniferum*, or the *poppy*, an annual plant, inhabiting Asia, in different parts of which, as well as in Egypt, it is abundantly cultivated for the sake of the opium which it yields. There are two varieties of the plant, the *white* and *black*, both of which afford opium; but it is said to be chiefly procured from the former. (See *Poppy Capsules.*) The juice, when collected, is put into convenient receptacles, and, after concreting into a proper consistence, is made up, either with or without addition, into masses of different shape, usually surrounded with leaves to prevent their adhering together, and then sent into market.

Commerce is supplied with opium chiefly from Hindostan, Anatolia or Asia Minor, and Egypt. It is produced also in Persia; but little or none is exported. The opium of Hindostan is either consumed in India, or sent to China, and reaches Europe and this country only as an object of curiosity. It is the product of the Asiatic dominions of Turkey, and that of Egypt, with which the western world is supplied. The opium consumed in the United States is chiefly the variety produced in Anatolia, and introduced into commerce through the ports of Smyrna and Constantinople. It is called Turkey opium, and is usually distinguished into two varieties, the *Smyrna* and *Constantinople opium*, so named from the ports from which they are respectively distributed. Of these, the Smyrna opium is the one most largely consumed in this country. Some Egyptian opium is occasionally imported; but is seldom kept in the shops.

1. *Varieties of Opium.*

The only varieties which it is necessary to notice are, *first*, the Turkey opium, including the Smyrna and Constantinople, and, *secondly*, the Egyptian.

1. TURKEY OPIUM.—This comes in masses of irregular size and shape, from half a pound to two and a half pounds in weight, originally probably spherical, but usually flattened, or irregularly angular, in consequence of the pressure to which they are subjected, while yet soft, in the cases containing them. On their outer surface are the remains of the leaves in which they were originally enveloped; and adhering to it, in greater or less number, the light reddish-brown capsules of a species of Rumex, added, no doubt, with the object of absorbing moisture, and preventing the adhesion of the lumps. These are usually, as first imported, soft and tenacious in the interior, but hard upon the surface. When completely dried by time and exposure, they are brittle, and have a somewhat shining though uneven fracture.

a. *Smyrna Opium.* Of the two varieties of Turkey opium, the *Smyrna* is most largely imported. It is, indeed, almost the only variety kept in our retail shops. Besides the characters above mentioned, it has the peculiarity, when cut into, and then torn, of exhibiting numerous minute shining tears, very obvious under the microscope, which somewhat resemble small seeds, and are no doubt the concrete drops of juice formed on the capsules, upon exudation, after these have been incised. Along with the tears are numerous minute pieces of the outer covering of the capsule itself, scraped off with the juice. The best Smyrna opium consists of these ingredients exclusively; but inferior specimens are often sent into market, variously and in different degrees adulterated, and frequently so much so as to unfit them for use in the shops. The adulterating materials are an extract made from the leaves, grapes freed from their seeds and crushed, different gummy matters, liquorice, minute stones or pieces of metal, etc. Different samples of Smyrna opium vary in the quantity of morphia they contain from 3 to 13 per cent. The better kinds ought to yield at least 8 per cent. to a careful analysis. Good Smyrna opium is of a light reddish-brown colour in the interior. When blackish, of a weak empyreumatic odour, a sweetish taste, a viscid or greasy consistence, an entirely dull fracture when dry, or containing obvious impurities, it should be regarded as inferior. If wholly without the Rumex capsules, or very scantily supplied with them, it may be looked on suspiciously, as probably of the kind which is said to be "made over again" in some of the Mediterranean ports.

b. *Constantinople Opium.* This, so far as it is a distinct variety, is characterized by the entire want of the tears which distinguish the genuine Smyrna opium. But the drug brought from Constantinople has probably been taken thither from all the different parts of the Turkish dominions where it is produced; and it is not, therefore, a matter of surprise that, under this name, Smyrna and Egyptian opium should have found their way into commerce.

2. Egyptian Opium.—This is in flat, roundish cakes, of different sizes, from half an ounce to a pound in weight, and often either wrapped in a poppy leaf, or presenting vestiges of the leaf, so applied that the midrib divides the cake into two equal parts. It has none of the Rumex capsules, and is always hard and brittle, breaking with a smooth fracture of a waxy lustre. It has usually much less morphia than good Smyrna opium, and should not be kept for use in the shops.

It is important that only good opium, of a strength at least approaching to uniformity, should be kept for internal use, or for making those preparations, the strength of which depends on that of the opium used; otherwise it would be impossible to have any fixed dose of this most important medicine, or to prescribe it with any certainty of obtaining its peculiar effects in the degree desired. The inferior kinds, should they be admitted into the country, ought to be employed exclusively by the manufacturers in the preparation of morphia or the other alkaloids.

2. *Properties of Opium in General.*

Good opium is of a reddish-brown or deep-fawn colour in mass, and when dry yields a yellowish-brown powder, which becomes adhesive at a slight elevation of temperature. When drawn over paper, it leaves an interrupted trace of a light-brown colour. Its odour is strong, narcotic, and peculiar; its taste bitter, somewhat acrid, and nauseous. When long chewed it irritates the mouth, and may even vesicate. It is inflammable. Water, alcohol, and the diluted acids extract its virtues, which, however, it will not yield to ether. The liquids impregnated with it have a deep-brown colour.

Composition. Besides several principles found in other vegetable products, as gummy and extractive matter, resin, a substance resembling caoutchouc, fixed oil, albumen, and various mineral substances in very small proportion, opium contains *morphia, narcotina, codeia, narcein* or *narceia, thebaina* or *paramorphia, papaverina*, and *opiania*, having alkaline properties, *meconin*, and *porphyroxin*, which are neuter, an acid denominated *meconic acid*, and a characteristic odorous principle, all of which are peculiar to opium. Morphia exists in it combined with meconic acid, and probably in small proportions with sulphuric acid. Of these principles the only one hitherto much employed in medicine is morphia. Narcotina, codeia, and narceia have been recommended for special purposes. Of the remainder, though some of them may be and probably are efficient in their action on the system, so little is positively known, that it will not be worth while to burden the memory of the reader with an account of their properties. The four particularly mentioned will be sufficiently described among the preparations of opium.

Incompatibles. Many substances produce precipitates with opium, which, as they do not affect its active principles, are not medically incompatible, so far as the opium itself is concerned. With the infusion, the alkalies throw down its alkaloids, and the astringents containing gallo-tannic acid, as well as kino, catechu, and rhatany, precipitate insoluble tannates of the same alkaloids; but alcohol, in considerable proportion, or an excess of acid, will redissolve the precipitate in both instances. Tincture of galls, notwithstanding the alcohol it contains, throws down a copious precipitate.

Tests of Opium. An infusion of opium reddens litmus paper, becomes turbid with solution of ammonia, assumes a deep-red colour on the addition of sesquichloride of iron in consequence of the formation of meconate of iron, is reddened by nitric acid, and is copiously precipitated by infusion of galls. But the only satisfactory test of its value is the proportion of morphia contained in it. Good opium, treated as directed in the U. S. Pharmacopœia for the preparation of morphia, should afford from 10 to 12 per cent. of the impure morphia precipitated from its infusion by a mixture of alcohol and solution of ammonia; and ether should not dissolve more than from 2 to 4 parts of this impure product.

3. *Effects upon the System.*

It may be said of opium, in general terms, that, being at first moderately stimulant to the parts to which it may be applied, and to the circulation, and energetically so to the nervous system generally, and especially to the brain, it subsequently operates with even greater energy and universality as an apparent sedative. But little idea of the real powers of the medicine would be obtained from such a definition of its effects. In order to form an exact and profitable conception of its influence, so far as known, it is necessary to follow it through the different functions, and trace its operation carefully in each, step by step. Its vast importance, and diversified applicability, call for more minute details than are necessary or advisable in relation to most other medicines. I shall consider it in relation *first* to the nervous system, *secondly* to the circulatory and respiratory systems, *thirdly* to other functions or organs, and *fourthly* to the part with which it may be directly brought into contact.

1. *Action upon the Nervous System.* From a full dose of opium, taken internally, no other immediate effect is experienced than a slight feeling of warmth, or perhaps of weight in the stomach. But in a short time, varying somewhat according to the form in which the medicine is used, and the state of the stomach, but seldom exceeding ten or fifteen minutes, and often much less, a sensation of fulness is felt in the head, soon followed by a universal feeling of delicious ease and comfort, with an elevation and expansion of the whole moral and intellectual nature, which is, I think, among the most characteristic of its effects. There is not the same uncontrollable excitement as from alcohol, but an exaltation of our better mental qualities, a warmer glow of benevolence, a disposition to do great things, but nobly and beneficently, a higher devotional spirit, and withal a stronger self-reliance, and consciousness of power. Nor is this consciousness altogether mistaken. For the intellectual and imaginative faculties are raised to the highest point compatible with the individual capacity. The poet never has brighter fancies, or deeper feelings, or greater felicity of expression, nor the philosopher a more penetrating or profounder insight, than when under the influence of opium in this stage of its action. It seems to make of the individual, for the time, a better and a greater man. Sometimes there may be delusion; but it is not so much in relation to the due succession or dependence of thought, as in the elevation of the imagination and the soul above the level of reality. The hallucinations, the wildness, the delirious imaginations of alcoholic intoxication, are, in general, quite wanting. Along with this emotional and intellectual elevation, there is also increased muscular energy; and the capacity to act, and to bear fatigue, is greatly augmented.

If the quantity of opium taken has been just insufficient to induce sleep, this delightful exaltation may continue for hours, supporting the mind and body under an amount of exertion, to which they would be wholly inadequate in their ordinary condition.

In two remarkable points, besides those mentioned, the operation of opium differs from that of alcohol; in the absence, namely, of that erotic excitement, and that incapacity of combined muscular movement for a given purpose, which are so strongly characteristic of alcoholic stimulation.

With the psychological phenomena above mentioned, there is very frequently a roaring, singing, or buzzing in the head, of which there is scarcely a consciousness, unless the attention is specially directed towards it. Sometimes these noises, combined with throbbings or thumpings in the brain, are somewhat disagreeable; but they are seldom sufficiently so to call back the mind from its higher flights, or the spirit from its keen enjoyments.

After a length of time varying, according to the dose of the drug and the susceptibility of the individual, from half an hour, to two, three, or four hours, or even longer, this exaltation sinks into a corporeal and mental calmness, which is scarcely less delicious than the previous excitement, and in a short time ends in sleep. Perhaps, in most instances, where a full dose has been taken, this result occurs within an hour. But, when the quantity of opium is insufficient for this effect, the individual will remain awake for hours, sometimes for many hours, even for the whole night, supposing the drug to have been given at bedtime, lying calmly and placidly, without mental effort or uneasiness, and submitting himself to a current of vague, but generally pleasing fancies.

Should the dose be sufficient only to induce a light sleep, there will be a constant succession of dreams, having the vividness almost of reality, usually pleasant in their character, but sometimes very much the reverse. I have repeatedly known patients to complain of excessively disagreeable effects from opium, and chiefly of horrible dreams with which they have been tormented during the night, and to declare that nothing would ever induce them to take the medicine again; but I have almost invariably found, under such circumstances, that by increasing the dose on a subsequent occasion, or by giving an additional quantity when such symptoms may have presented themselves, that sound sleep is induced, and all discomfort vanishes. So real do these dreams appear, and so much like waking thoughts, that patients will often assert that they have not closed their eyes all night, when the fact is that they have scarcely been awake during that time.

The illusions of opium are so strong that one who uses the drug habitually can sometimes scarcely distinguish them from realities; and I have known intelligent, well educated men, having the ordinary regard for opinion, and perfectly free from any suspicion of insanity, to make statements, in the presence of numbers, as to occurrences which were known to every one present to be impossible, but were as fully believed by themselves as any other event of ordinary life; and I have been able to explain such aberrations, only upon the supposition that the dreams produced by opium had been mistaken for realities. I have no doubt that perfectly truthful persons have thus got the credit of habitual mendacity, when in fact their only immorality was the habitual use of opium, perhaps to relieve sufferings otherwise intolerable.

When opium exercises its full soporific influence, the sleep is usually profound and dreamless, and continues for about eight or ten hours. Should the patient be awakened before the direct effect of the medicine has been exhausted, the feelings of comfort or *bienaise* before experienced will often continue for hours in the following day; and I have known the same thing to happen repeatedly even after a good night's rest. But generally, upon awaking from the full uninterrupted effects of opium, the patient experiences a state of greater or less depression, indicated by languor and listlessness, a relaxed surface, a rather feeble pulse, and not unfrequently loss of appetite, nausea, and even vomiting. This, however, gradually passes away, and the system returns to its ordinary condition, without having experienced any appreciable disadvantage.

A remarkable *diminution of sensibility* attends the narcotic operation of opium, beginning even before the soporific effect, and continuing in a greater or less degree throughout the direct action of the medicine, and even into the secondary stage of depression. It is the general sensibility, or that to painful impressions, which is first and most prominently affected; but the special senses are in some degree involved, especially under the influence of very large doses; though I have met with no instance, even of opium poisoning, in which, until the advanced stage when profound coma had set in, the patient could not hear and see when roused. In this respect opium differs strikingly from some other narcotic medicines, and especially belladonna.

2. *Action upon the Circulation.* It was long an undecided point, whether opium was to be regarded as stimulant or sedative. The experiments of Dr. Crumpe, published in 1793, decided, what any one might have determined for himself by counting his own pulse under a dose of opium, that, in its first operation, it is stimulant at least to the circulation. Within ten or fifteen minutes after its administration, the pulse is, in general, moderately increased in frequency, fulness, and force, and at the same time the surface of the body becomes warmer, and the face somewhat flushed. When the period of general excitement is past, and that of calmness or drowsiness supervenes, the pulse either resumes its original condition as to frequency, or, under a large dose of the opium, becomes somewhat slower, retaining, however, its fulness and for a time its force. In this condition it continues for some time during the period of sleep; but then gradually relaxes, and becomes soft with the relaxing surface, and in the end, participates in the general depression which attends the cessation of the direct influence of the medicine.

With the increased frequency of the pulse, the respiration is also somewhat quickened; and, as the former becomes slower, the latter undergoes a similar change, and generally even in a greater degree. Under the full influence of opium, one of the most striking phenomena is the relative slowness of the breathing, which is sometimes even stertorous, when the sleep is profound.

Corresponding with the condition of the circulatory and respiratory movements is that of the blood itself. Retaining its florid colour for a time, it may give a bright tint to the complexion during the stage of excitement; but, with the diminished influence from the respiratory centres, the change from venous to arterial is less thoroughly effected, and the blood becomes darker-hued. This is not very obvious from ordinary doses of opium; but, when it has been very largely taken, the venous hue upon the surface, and particularly in the face, is often conspicuous.

3. *Action upon other Functions or Organs.* Some other effects of opium, which may be considered as more local than the preceding, are yet very important in a therapeutical point of view.

On the secretions its influence is especially worthy of notice. Most of them are diminished by it, perhaps all occasionally; but some are at times promoted, and one, that, namely, of the surface, generally so. The *mucous secretion* is almost invariably diminished. Hence, in part, the remarkable *dryness of the mouth, nostrils,* and *fauces,* which characterizes the action of opium. The same deficiency probably exists throughout the alimentary canal, contributing to the *thirst* which is among its prominent symptoms. There is often also a feeling of *dryness in the conjunctiva* from the same cause. The secretion of the *salivary glands* is certainly diminished, and probably that also of the *pancreas.* The *secretory function of the liver* is much impaired by a continued use of the medicine, as may be known by the light-coloured passages from the bowels. This I have very often noticed; and it is one of the effects which the physician will have most frequently to counteract. There can be little doubt that a single dose produces a proportionate effect. The *kidneys* are variously affected. In the greater number of instances their secretion is diminished, especially when the patient is warm in bed; but I have sometimes known it to be powerfully promoted, particularly by the salts of morphia. Indeed, I have seen few diuretics act more copiously than this for a short time; and the effect generally takes place in the course of the first hour or two after the administration of the medicine. It is most apt to occur when the skin is kept cool.

The *diaphoretic effects of opium* are well known. I seldom, however, witness this effect when the patient is walking about. When he is warmly covered in bed, it is extremely common; and sometimes the discharge is profuse. It does not usually come on until the patient has slept for some time, and is most copious towards the end of the period of sleep. It is very common to awake in the morning bathed in sweat. This diaphoretic property is greatly increased by the addition of ipecacuanha.

The *itching sensation in the skin* which opium is apt to produce may be referred to in this connection. It is sometimes attended with prickling, and may occur in any part of the body. It is often very annoying to the patient, and may even prevent sleep. In some instances, it is attended with a *miliary, erythematous,* or *urticarious* eruption; but this effect is relatively rare; at least I have seldom noticed it.

The *stomach* may be at first moderately excited by opium; but the effect soon ceases, and is followed by a marked diminution of its function. The appetite is diminished, and the digestion impaired. These effects may be ascribed perhaps in part to a diminution of the secretion of gastric juice and mucus; but are probably mainly dependent on a want of the accustomed influence from the nervous centres, and the diminished call for food from the nutritive function.

The *bowels are generally constipated.* This is among the most constant effects of opium, though it is not invariable. It probably depends on different causes, among which may be mentioned the diminished secretion of bile, of pancreatic liquor, and of mucus, and the diminished supply of chyme from the stomach; but the chief cause is probably a deficiency of influence from the organic nervous centres, through which the muscular coat becomes enfeebled, and, as it were, partially paralyzed.

The activity of the *nutritive process* is much diminished; and consequently less food is required. This is much more obvious from the habitual use of opium, than from a single dose; but there can be no doubt that the latter produces the same effect in a proportionate degree. It does not follow that emaciation must take place. On the contrary, the body often retains its weight, and sometimes even gains under the continued use of the drug, if not taken in great excess. This is explained by the consideration, that the normal disintegration of the tissues is diminished equally with nutrition, and even in a greater degree.

Not only the voluntary muscles, and those of the alimentary canal, suffer a diminution of their power in the second stage of the action of opium, but *those of the bladder also*, so that there is occasionally some difficulty in passing the urine from this cause; but the effect is seldom obvious, unless from very large doses.

4. *Action on the Part to which the Opium may be Applied.* To whatever part opium may be applied, if vital, it is capable of producing its general effects. Injected into the rectum, or sprinkled upon the skin deprived of the epidermis, it operates with almost as much certainty as when swallowed. In the lower animals, when introduced into the cellular tissue, it acts with great energy; in the peritoneal cavity, produces convulsions and death; and in the cavity of the heart, weakens or suspends its action. Through the skin, protected by the epidermis, it acts very slowly and feebly upon the system.

Upon the part itself with which it is brought into contact, it produces a series of effects analogous to those upon the system generally. The first effect is slightly to stimulate, the second to diminish sensibility and the power of action. Thus, when in contact with the conjunctiva, the mucous membrane of the nose and urethra, the blistered skin, or the surface of wounds or ulcers, it first occasions heat, pain, and some degree of inflammation; and it has already been stated that, when long chewed, it will sometimes blister the mouth; but, after a time, the pain ceases, and the several surfaces become less sensible to ordinary impressions upon them. Even through the cuticle it is capable of producing some anodyne influence.

5. *Idiosyncrasies.* On certain individuals opium produces peculiar ef-

fects, which differ according to their several idiosyncrasies. Thus, in some persons it causes much more than the usual degree of excitement, intoxicating them like alcohol, rendering them more or less delirious, and even producing convulsions. It is said to have these effects frequently on the negro and the Malay; but I have not observed any special peculiarity of the kind in negroes of this region. In some, it gives rise, even in large doses, to headache, restlessness, and utter inability to sleep; while in others it acts with extraordinary energy as a soporific, even in small doses. There are individuals who, when they take it, always suffer excessively from nausea and vomiting, and occasionally with spasm of the stomach. Not a few, though they experience in the same manner as others its direct influence, yet are so much troubled with subsequent nausea, and general distress, as to preclude the use of the medicine in their cases. It is said even to purge some individuals, and in others to produce colic. I have repeatedly known it, in merely stimulant doses, to provoke an attack of neuralgic pain, in a person liable to this affection. The probability is, that some of these abnormal effects are owing to certain constituents of opium which are generally productive of no inconvenience, or to the peculiar mode in which the active principles may be combined or associated in the drug. It is certain that they may very frequently be obviated by particular modes of preparing the opium for use, consisting either in separating from it the obnoxious matters, or modifying the state of its active matter. Thus, morphia, or the black drop, or the aqueous extract, or the deodorized tincture, can be borne well, when opium itself, or other preparations would be rejected from the stomach, or, if retained, would occasion great inconvenience.

6. *Effects of Variation and Repetition of the Dose.* As a general rule, in reference to the operation of opium connected with the quantity administered, the stimulant effect is protracted by a diminution, and shortened by an increase of the dose; while exactly the reverse is true of the subsequent narcotic effect, the intensity of which is proportionate to the amount taken.

There are few medicines to which the system becomes more rapidly habituated than this. By increasing the dose at short intervals, the quantity which may be swallowed, with present impunity, may be indefinitely augmented. An ounce or more is frequently consumed daily; and even pints of laudanum have been taken in the same time.

7. *Acute Poisoning.* It has been said that poisonous quantities of opium sometimes occasion no stimulant effect whatever, but are immediately sedative. I have never seen a case which would justify this statement, and do not think that the fact stated is possible. Opium is not sufficiently stimulant to overwhelm the stomach, as enormous quantities of alcohol may do, and produce almost instant death, without directly reaching the brain. Before any very powerful effect can take

place, time must be allowed for absorption. The drug cannot all be absorbed at once. A small portion must first enter the circulation, and, when this reaches the brain, it must act upon it as a stimulant. And such I believe to be invariably the case, when opium has been swallowed. I have no doubt, moreover, that a careful examination made at the beginning will discover evidences of this stimulation. I have heard of one instance in which an individual, who had taken a poisonous dose, walked a distance exceeding a mile, and back again, before the narcotic effects were experienced. A very powerful emotion, wholly preoccupying the mind, may have the effect of postponing the operation of the poison, and in some measure counteracting it, as physical pain is known to do, for example, in violent colic and tetanus. But, generally speaking, the larger the quantity of the opium taken, especially in a liquid form, the shorter is the period of unmixed stimulation. In a very short time, under a poisonous dose, drowsiness comes on, soon followed by profound stupor. The patient becomes apparently quite senseless, and lies without other observable motion than that of respiration, which is very slow, and not unfrequently stertorous. A dark suffusion of the countenance comes on, with an utter want of expression. So common is this, that, by its absence, I have been able to detect a case of pretended poisoning from opium. The eyes are closed, and the pupils almost always contracted at this stage. The pulse is slow, and generally full and strong, not unlike that of apoplexy, and indicating anything but feebleness in the heart's contractions. I have known it to be so extremely forcible as almost irresistibly to call for the use of the lancet, lest injury might be done to the brain. The coma, however, is not complete for several hours. The patients are almost always capable of being roused, and kept for a time partially awake, by being dragged, half walking, around the apartment. Under such circumstances, however, they are extremely desirous to be allowed to sleep; and the only motive by which, in some instances, I have been able to induce them to swallow the drink or medicine offered, has been to assure them that, if they would take it, they should be allowed to rest for a time. During this half-awake condition, it is surprising to notice the change in the colour of the surface, which, before almost purplish from the venous hue of the blood, now reassumes, in a considerable degree, its natural appearance; but the instant the patient is permitted to lie down and sleep, the dark suffusion of face returns, with the slow, laboured breathing. Convulsions are said sometimes to occur; but, though I have seen numerous cases of poisoning from opium, I have met with them in no one instance. The whole of the voluntary muscles appear relaxed and powerless. The skin, too, is relaxed, but not often perspiring at this period. Death seldom takes place in this stage of cerebral oppression. After a few hours, the coma becomes more profound, so that the patient can no longer be roused. The venous suffusion of the countenance begins to give way to paleness. The skin becomes cooler and more relaxed. The pulse, though in general still slow, diminishes gradually in fulness and strength. The breathing becomes slower and slower, till at length a considerable interval elapses between the successive inspirations. I was once struck with this state of respiration in a child, whom I had been attending for catarrhal fever. Suspecting that some mistake had been made in the prescription, and that opium had been given in a large dose, I took the parent of the child with me to the shop of the druggist, and found that a cough mixture had been prepared with at least twelve times the quantity of morphia directed. Happily, though alarmingly ill, the child recovered under supporting measures. At length a condition of utter prostration ensues; the pulse ceases to be perceptible at the wrist; there is a universal cold clammy sweat over the body; the respiration, occurring at lengthening intervals, at last ceases; and death apparently takes place. The heart, however, yet beats very feebly; and a short period is still allowed for the application of restorative measures, before the case becomes quite hopeless.

The stage of prostration usually commences from four to six hours after the swallowing of the poison, and sooner if it has been removed artificially from the stomach; and death generally occurs in from six to twelve hours. If the patient survive the twelfth hour, he usually recovers, though instances are on record in which the fatal termination has taken place much later. It has sometimes also occurred before the sixth hour, even so early, it is asserted, as the third. In such a case, the patient dies from the immediate influence of the opium on the brain, as in congestive apoplexy. Ordinarily, I believe, death results from the vast prostration of the nervous power, consequent upon the previous excessive excitement; and, if the patient can be supported through this period of collapse, he will in all probability recover. From a quantity just insufficient to cause death, the prostration following the congestive influence of the poison is extreme; but, at the lowest point, the system begins to react, and gradually returns to health, though frequently through a series of nervous disorder and variously deranged function, which mark the violent strain to which the brain has been subjected.

The quantity of opium which may prove fatal varies so much with constitutional peculiarities, or the existing state of the system from any cause, that it is quite impossible even to approximate the fatal dose in reference to any particular individual. Dr. Christison, in his treatise on poisons, mentions an apparently well authenticated case, in which death took place, in an adult man, from four grains and a half of opium with nine grains of camphor; whereas half a fluidounce of laudanum has been repeatedly known to be taken, by persons not accustomed to the use of opium, without such a result. Death often occurs from quantities varying from half a fluidounce of laudanum to two or three fluidounces, or from about twenty grains to one or two drachms of opium. Infants are peculiarly susceptible to the poisonous influence of the drug. I was once called to see a child, between one and two years old, in a dying state, to whom its mother had given, rubbed up with water, the residuary matter in a teaspoon, after the evaporation of some laudanum which had been left in it. She thought she might be able to obtain enough in this way for a dose. Dr. Alison, of Edinburgh, has seen death result in a child, a few weeks old, from four drops of laudanum; and two and a half drops killed another child, three days old. (*Christison on Poisons.*) The inference to be drawn from these facts is, that great caution should be observed in exceeding the ordinary full dose of opium, which experience has shown to be safe. It may be very frequently done with impunity, but at any time a fatal result may occur. I do not think that it is ever necessary, under any circumstances, to give more than two grains, as a beginning dose, to an adult wholly unaccustomed to the medicine. It can be repeated in a short time, if necessary, and may be increased after testing the susceptibility of the patient. For an infant, during the first week or two, not more than half a drop of laudanum should be given at first, and to one a year old not more than two drops.

In some rare instances, after a poisonous dose of opium has been swallowed, vomiting has come on spontaneously, and saved the life of the patient by discharging the poison.

Opium may prove poisonous, as well when injected into the rectum as when given by the mouth; but it is probable that a larger quantity would be required to produce fatal effects. Some doubts, however, have been thrown upon the supposed relative insusceptibility of the rectum; and cases have occurred in which comparatively small doses, exhibited by enema, have produced alarming effects. An instance has been reported by Dr. Anstie, of London, in which a man died from the effects of three grains of morphia injected into the rectum. (*Med. T. and Gaz.*, Feb. 1863, p. 134.) Still, such cases may be regarded as exceptional, depending on idiosyncrasies of the patients; and the opinion that more of the narcotic is required to produce a given effect administered by the rectum than by the stomach is probably true as a general rule. Opium is asserted to have destroyed life by application to the surface of the body. A flaxseed poultice saturated with laudanum, and applied to the leg of a soldier affected with erysipelas, is said to have proved fatal. (*Christison on Poisons.*) The case of a young man is reported in the *Annuaire de Thérapeutique* (A.D. 1843, p. 5), who was thought to have perished through the effects of a cataplasm to his epigastrium, upon which the contents of a laudanum bottle had been poured. A medical friend of my own, in whose word I place entire reliance, reported to me the case of a child destroyed by the repeated external application of laudanum. In these cases, it is not specially stated whether there was or was not abrasion of the skin; but, if the poison is fatal upon the sound skin, how much more likely to be so upon a denuded surface, or upon an ulcer or wound! Laudanum should never, therefore, be used recklessly even as an external remedy.

The *morbid appearances after death* from laudanum are, as a general rule, congestion of the brain, with more or less serous effusion, congestion of the lungs, a livid hue of the surface, and a liquid state of the blood. In a few instances, effusion of blood has been found.

Treatment of Acute Poisoning. There is no antidote to opium which can be relied on. The important indications are to evacuate the stomach, and to support the system in the state of prostration which follows the direct influence of the poison. The first indication is to be met either by emetics, or the stomach-pump, or by the two combined. If called at any period before prostration has taken place, one of these measures should be resorted to. For various reasons, I prefer first the trial of emetics. They are, in general, more immediately at command, and time is an object of much importance. Besides, if solid opium has been swallowed, it must remain in the stomach, when the pump is used, if in masses too large to pass through the tube. I was once cognizant of a case of this kind. A young man was brought to my house, with the statement that he had taken solid opium. He was sent immediately to the hospital, where, as I afterwards learned, the stomach-pump was promptly applied, and everything apparently evacuated. The patient, however, died. I was convinced that a portion of opium had remained in the stomach, because too large to enter the tube; and from that time I determined never to depend on the stomach-pump, in any case where opium had been swallowed in mass, however small the fragment. Besides, there may be an hour-glass contraction, which might yield to an emetic, but not to the stomach-pump. I once attended a case in which, after the contents of the stomach seemed to have been completely discharged under the influence of emetics, a sudden gush of liquid was thrown up, smelling strongly of laudanum. Had the stomach-pump been relied on in this case, it might have ended fatally. When emetics cannot be made to act, this instrument should be resorted to; and it may often also be advantageously used in conjunction with emetics, especially when the patient refuses to swallow, as it then affords the means of introducing the medicine into the stomach.

The emetics I prefer are sulphate of zinc and ipecacuanha. The former is very prompt and energetic, safer in large doses than sulphate of copper, because less corrosive, and than tartar emetic, because less sedative or prostrating in its influence. The ipecacuanha is also a quick and active emetic, at the same time that it is safe in almost any quantity.

Thirty grains of sulphate of zinc, and a drachm of ipecacuanha may be given at once, and repeated every twenty minutes until they operate. Indeed, the ipecacuanha may be thrown in *ab libitum*. I should fear an indefinite repetition of the sulphate; for, though it may produce no perceptible irritation at the time of exhibition, in consequence of the want of susceptibility in the stomach, it may yet leave an impression behind, which, upon the occurrence of reaction, may end in inflammation. In a case of opiate poisoning in a woman, which occurred to me many years since, the patient, after the evacuation of the poison, was reduced to the lowest state of prostration, from which she was saved with difficulty. Among the measures employed to excite her, was a pair of sinapisms applied to the legs. As, in the existing insensible state of the skin, they produced neither pain nor redness, they were allowed to remain on for three hours. When they were taken off, no rubefaction was visible. But when the system reacted, violent inflammation took place in the surface with which they had been in contact, followed by vesication and obstinate superficial ulceration, which was long in healing. Applying this observation to the influence of irritants on the stomach, I felt convinced that, by giving largely of substances of this kind, though they might not act at the time, we might upon the occurrence of reaction have violent and perhaps fatal gastritis. It is probably not going too far to say, that some of the deaths in narcotic poisoning, which have occurred notwithstanding the complete evacuation of the poison, may have resulted from this cause. I have never, therefore, proceeded further with the sulphate of zinc than to give three doses; and have not ventured on sulphate of copper at all. Yet I have never failed in evacuating the stomach by emetics, when I have employed them in these cases.

The emetic, however, should be aided by various accessory measures. Among the most important of these is the use of large quantities of warm water, or warm chamomile tea, of which the patient should be made to swallow tumblerful after tumblerful, until the stomach will receive no more. The throat also may be tickled by a feather, in order to rouse the stomach by its sympathies. The great difficulty, however, is not so much in the direct insusceptibility of the stomach as in that of the cerebral centres, through an impression upon which it is that emetics are enabled to act. It is, therefore, important to rouse these centres, and render them more sensible to the nauseating impression. For this purpose, cold water may be dashed on the face, head, or neck of the patient.*

---

* The case of a woman is recorded by Dr. A. Le B. Monroe, of Medway, Massachusetts, in which life seems to have been saved, after the swallowing of two ounces of laudanum, by placing the patient on her back, and pouring on the naked epigastrium, from a height of nine feet, a small stream of water from a pitcher. Before the second pailful was exhausted, there were signs of improvement; and after the third, she was restored to consciousness. She was then kept walking about the

If the pulse is exceedingly full or strong, some blood may be taken from the arm, in order to lessen, in some measure, the pressure on the brain. But this measure must be used with great caution. The prostration following the direct action of the poison is generally the greatest danger of the case. Anything which may increase that prostration may be hazardous. My preceptor, the late Dr. Joseph Parrish, used to relate the case of a young woman to whom he was called in the country, and who had swallowed a poisonous dose of laudanum. The physician in attendance, influenced by the state of her pulse, had bled her largely, and I believe more than once. The consequence was, that, after the evacuation of the poison, though she recovered her consciousness perfectly, she fell into a prostrate condition from which it was found impossible to raise her. Another and, perhaps, the most important adjuvant of the emetic, is to keep the patient in constant motion until vomiting is induced. For this purpose, assistants should aid him in walking steadily about the room, and, when there is resistance, should use compulsory measures to this end if necessary. It is surprising, sometimes, to witness the efficiency of this measure in relieving the cerebral congestion. While moving, the patient remains at least partially awake, the colour of the face brightens, and more or less expression comes into his features; but the instant that he is allowed to lie down, he falls again into a deep, perhaps stertorous sleep; and the dark suffusion of face, and utter want of expression return. Bouchardat recommends that the patient be kept awake for twelve hours, so as to prevent the paralyzing influence of the absorbed narcotic on the nervous centre of respiration, until the poison shall have been discharged by the kidneys. (*Ann. de Thérap.*, 1862, p. 3.)

It is not sufficient to obtain a single evacuation of the stomach. After vomiting has begun, it should be kept up by free draughts of warm water, until the liquor returns colourless and odourless.

If the stomach-pump is employed, the same thorough evacuation should be effected. The water injected should return without smell, and the last liquid contents should be drawn out by means of the syringe.

But the subsequent treatment is all-important. It has not fallen to my lot, out of numerous cases of this kind which I have seen, to witness death in a single instance, except in that of the infant before referred to, and that occurred at a period when all the resources, now at our com-

---

apartment for some time, and ultimately recovered. (*Boston Med. and Surg. Journ.*, May 31, 1866, p. 354.) Yet the direct influence of cold, except for the shock, would seem to be injurious. Brown-Séquard recommends that the patient should be kept warm; asserting that, if of two animals, poisoned with opium, one be placed near a fire and warmly covered, and the other in some cold place, the former, *cæteris paribus*, will live, while the latter will perish. (*Dublin Quart Journ.*, May, 1865, p. 484.)—*Note to the third edition.*

If the ordinary operation of opium be compared with that of alcohol, the cause will be obvious why life is so much less endangered by the former than the latter. The stimulant influence of opium, either on the part to which it is applied, or generally on the circulation, is very much less than that of alcohol; nor does it equally excite the functions of the lungs, liver, and kidneys. Hence it is much less liable to induce either chronic inflammation of the different organs, or that organic degeneration, which almost necessarily attends the debility consequent upon excessive vascular excitement. Operating mainly on the functions, the disordering influence of opium is witnessed chiefly in the functions.

Occasionally the medical man is consulted in this country by the slaves of opium, and has the opportunity of witnessing the consequences of its excessive abuse. In his own therapeutic observation, he also witnesses frequent disturbance of the functions from its medicinal employment, and necessarily infers that the same disturbances must exist in those who use it as a luxury within the same limits. The greatest sufferings experienced by the opium-eater are those which attend the state of nervous depression, always existing when its direct influence is no longer felt. There are excessive restlessness, a universal and indescribable uneasiness, feelings of intolerable distress, especially in the epigastrium and lower extremities, an irksome sense, moreover, of incapacity both for intellectual exertion, and for mental or emotional enjoyment, constituting together a state of exquisite misery, from which the only relief is by renewed recourse to the stimulus, which, if taken in an increasing dose, renders him happy again, and again capable of exertion; and thus he goes on, in an alternation of lessening comfort and increasing misery, to the end. At the same time, there is a gradual depravation of the functions, which impairs the degree of health, though it may not very materially shorten life, unless the indulgence be carried to great excess. The ordinary derangements of the organic functions are impaired appetite and digestion, habitual constipation, and defective action of the liver; those of the animal functions, tremors, wakefulness, weakened memory and intellect, and loss of interest in the usual concerns of life and social relations. The lowest stage of degradation has been attained, when the indulgence ends in a total loss of self-respect, and indifference to the opinions of the community; and everything is sacrificed to the insatiable demands of the vice. Not unfrequently, this habit of excess has been engendered by the supposed necessity of obtaining relief from painful affections, such as cancer, and certain incurable cases of neuralgia; but, though some palliation, this is no satisfactory excuse; for, by proper management, considerable relief of pain can generally be obtained, without an excess sufficient to degrade the mind, or even materially the general health; and it is rather a weak yielding to the seductive pleasures of opium, than any necessity for its anodyne influence, that leads to the lowest depths of the evil.

The effects of the vice of opium-eating, and opium-smoking, among the lower class of the Orientals, have been frequently described, and with such warm colouring that a suspicion is apt to arise of some interference of the imagination in the pictures given; especially as we do not meet their exact counterparts among those, who perhaps equally abandon themselves to the vice among ourselves. It is possible that the fumes of opium inhaled may exercise a more deleterious influence on the health than the drug taken into the stomach; and this may explain the incompatibility of the descriptions of travellers with our own observation. Dr. Oppenheim, one of the most recent and reliable observers, gives the following account of what he has himself witnessed in European and Asiatic Turkey. The opium-eater usually begins with from half a grain to two grains, and gradually increases to two drachms and sometimes more in a day. He is readily recognized by his appearance. "A total attenuation of body, a withered yellow countenance, a lame gait, a bending of the spine frequently to such a degree as to assume a circular form, and glossy deep-sunken eyes, betray him at the first glance. The digestive organs are in the highest degree disturbed, the sufferer eats scarcely anything, and has hardly one evacuation in a week; his mental and bodily powers are destroyed; he is impotent." Finding the stimulant effect of the poison at length almost lost, he conjoins with it the use of corrosive sublimate, gradually increasing the latter till it amounts to ten grains daily. He becomes subject finally to neuralgic pains, to which the opium yields no relief; and, if he has begun the use of the drug early in life, seldom attains the age of forty. (*Brit. and For. Med. Rev.*, iv. 394.) It is unnecessary to state, that the corrosive sublimate has probably quite as much to do with the fatal result as the opium.

It is satisfactory to know that this evil habit may be corrected, without great difficulty, if the patient is in earnest; and, as the disorders induced by it are mainly functional, that a good degree of health may be restored. It will not answer to break off suddenly. No fortitude is sufficient to support the consequent misery, and life might be sacrificed in the effort. Of the particular phenomena which might result I have no experience; for I have met with no case in which the attempt has been made, or at any rate more than momentarily persevered in. Dr. B. H. Coates, however, states that he has seen well characterized cases, in which delirium tremens occurred (*N. Am. Med. and Surg. Journ.*, iv. 84); and this result might be reasonably anticipated. The proper method of correcting the evil is by gradually withdrawing the cause; a diminution of the dose being made every day, so small as to be quite imperceptible in its effects. Supposing, for example, that a fluidounce of laudanum is taken daily, the abstraction of a minim every day would lead to a cure in somewhat more than a year; and the progress might be much more rapid than this. Time, however, must be allowed for the system gradually to regain the healthy mode of action, which it had gradually lost.

4. *Mode of Operating.*

Opium probably acts simply by an influence upon the vital properties of the tissues, without any chemical reagency whatever. Hence the long comparative impunity under its abuse. At one time I was disposed to think that its first stimulating action on the heart and brain might be owing to a sympathetic impression extended from the stomach; but the correctness of this opinion seems to me more than doubtful, now that we know how rapidly it is absorbed, and how quickly it may be conveyed with the blood to all parts of the system. That it is absorbed is proved by the fact that, in fatal cases of poisoning, it frequently happens, even when there has been no vomiting, that none of it is found in the stomach. Besides, the smell of opium is sometimes observable in the breath and excretions of persons who have taken it largely, and has been noticed in the blood. Barruel asserts that he has detected morphia in the blood and urine of a person poisoned with opium. (Pereira, *Mat. Med.*, 3d ed., p. 2120.) The milk of nurses under its influence has produced its peculiar effects on the sucking child. When introduced into the jugular vein, it has been found to produce the same effects as when taken by the stomach. Finally, if applied to a nerve, without access to the blood-vessels, it does not act on the brain.

From its slightly stimulating effect on the surfaces with which it is observably brought into contact, it may be supposed, when in the circulation, to exercise a similar influence wherever it is carried, and thus to produce the moderate excitement of the heart which accompanies its primary operation. But its influence is felt especially by the nervous centres in the brain, and more particularly by those of the cortical portion of the cerebrum, through which the intellectual and emotional functions of the mind are probably exercised. The sensory centres, and the respiratory centre in the medulla oblongata, appear also to be specially affected. But if the cerebellum be, as supposed by Flourens, the seat of the power of combining motions, and as Gall and Spurzheim maintain, that of the sexual propensity, it probably participates little in the original stimulant impression. The operation of opium upon the nervous centres I maintain to be essentially stimulant. The primary mental excitement may thus be readily accounted for, as well as the more rapid respiration, and increased muscular power. It is not improbable that the stimulation of the heart may really proceed from a similar cause, and not from the direct contact of the opium or its active principles. But how account for the subsequent calm in all these functions, and the remarkable diminution and almost suspension which follow, as indicated by the impaired sensibility and power of motion, and the soporose condition more or less profound? Are these the result of a direct sedative or depressing influence following the stimulant? I think not. The real depression takes place long subsequently, after the direct action of the medicine has ceased. They are readily explicable upon the general doctrine of irritation, which I have maintained in this work and elsewhere. Irritation is stimulation beyond the healthy point. The two terms may be considered as synonymes in reference to our present purpose. When, then, a part is stimulated, it receives an additional supply of blood, and the supply increases with the stimulation until it ends in inflammation. Now the first effect of the blood entering the part is to supply the means for an increase of its healthy function; a larger supply interferes with the due action of the part, though the excitement may still continue; a still further quantity overwhelms it, and impairs or suspends altogether the exercise of its function. In other words, the effects of stimulation upon any part are first to augment, then to derange, and lastly to impair its function; and all this through the direct influence of the stimulant. Apply this law to the action of opium on the cerebral centres. It first moderately stimulates and moderately congests them; thus increasing their function, and giving rise to the elevated intellectual, emotional, and sensory phenomena, and perhaps to the circulatory and respiratory excitement, which characterize the early period of its operation; it continues to stimulate, and thus further congests them, and in this way occasions the disordered sounds and other sensations, and the derangement of the intellectual, emotional, and motor functions which sometimes come on at this period; it still continues to stimulate, and yet further to congest the centres, the functions of which are now diminished or suspended, causing first a sensorial calm, and ultimately sleep. If the quantity of the opium is very large, the congestion is hastened and increased with the more prompt and powerful stimulation; and hence the speedy occurrence of profound sleep or coma. The influence upon the circulation and respiration corresponds with this view. In active congestion of the brain the pulse usually becomes slower, fuller, and stronger, and the respiration slower and deeper; and thus it is in the early stage of the soporose effect of opium, showing that the sensorial phenomena proceed from a similar influence. Indeed, there is a marked resemblance between the effects of opium and a gradually increasing active congestion of the brain. In the latter, as in the former, the cerebral functions are first somewhat excited, then they are discomposed, as shown by abnormal sounds, etc., in the head, and then diminished or suppressed, as proved by the drowsiness and stupor which supervene; and the resemblance is extended, as already stated, to the respiratory and circulatory functions.

Thus far we have been attending to the direct influence of the opium.

The condition which follows is in accordance with another general pathological law, that every over-excitement must be followed by a corresponding depression. The cerebral centres, no longer stimulated by the opium, fall necessarily into a depressed state. No more blood is now attracted to them. They have not even the power of expelling the excess which has overwhelmed them. Hence, a failure of all the dependent functions, and the universal prostration that ensues.

I consider the above question as not purely theoretical, but highly practical in its bearing, and therefore important to be decided correctly. If opium is a real sedative to the nervous centres in its second and most powerful action, then it must be the great remedy in all cases of over-excitement of the brain, from slight vascular irritation of that organ up to apoplectic congestion, and even inflammation; for the sedative influence would vastly overbalance the stimulant, especially if the medicine should be given largely, and would thus produce much more good than harm. But every experienced practitioner knows that these are exactly the conditions in which opium is calculated to do harm. If, on the contrary, it be altogether a stimulant to the brain throughout its direct action, whether during the excitement or suppression of the cerebral functions, then it is contraindicated in the conditions just referred to, and would be most appropriate in all cases of functional depression or debility of the brain; and this is really the case. Upon the principle here stated, opium may be prescribed rationally; upon the other, that, namely, which considers it sedative to the brain, it must be given empirically.

But another important point, in reference to therapeutics, is that, while opium is a powerful *cerebral* stimulant, it operates really as a sedative upon many of the functions and organs of the body, which are sustained in their due state by influence from the nervous centres. By the over-stimulation of these centres, it disables them from extending their proper influence to other organs, and thus acts as a positive, though indirect sedative to the latter. Hence, opium may often be prescribed with great advantage as a sedative in various disordered conditions of the system, provided the brain be either sound, so as not to be materially injured by its action, or depressed, so as to be benefited by it. Under the therapeutic head, there will be frequent opportunities of illustrating the principle here laid down.

It is highly probable that, upon all the nervous centres, those of the spinal marrow and the sympathetic ganglia, for example, and upon all the force-generating nervous matter as distinguished from the mere conveying structure, wherever it may exist, opium acts in the same manner as upon the brain, though in a less degree. Sufficient investigation, however, has not been made upon this point, to justify a positive conclusion.

5. *Therapeutic Application.*

Opium has been known, and probably used, from the earliest period of Grecian history. It ranks among the most important medicines, and, in the variety of its applications, and extent of its employment, stands at the very head of the catalogue. I shall first treat briefly of the indications it is calculated to fulfil, and afterwards, more at length, of its special uses.

a. *Indications for the Use of Opium.*

1. *As a General Stimulant.* It will be remembered that opium, in its primary action, stimulates the circulation moderately, and the nervous system energetically. In reference to these properties, it is indicated in most acute affections in which the vital powers and functions generally are enfeebled, as in low fevers, etc. An important consideration, in this application of opium, is that its stimulant operation continues longer, in quantities just insufficient to produce its narcotic effects, than in the full anodyne and soporific dose. Hence, as a mere stimulant, it should be given in rather small doses, which should be repeated at such intervals as to sustain a steady operation, without allowing the effects of successive doses to accumulate, and thus to bring about the indirect sedative influence of the medicine. One-eighth, one-quarter, or one-half a grain may be given for this purpose every two, four, or six hours, the smaller quantity being given at the shorter, and the larger at the longer interval. This rule applies to cases possessing the ordinary healthy susceptibility to the action of opium. Should the susceptibility be materially diminished by the disease, the dose must be increased accordingly.

2. *As a Nervous Stimulant.* In quantities insufficient to produce any material or very sensible impression on the brain, opium acts precisely like the nervous stimulants, and may be employed for similar purposes. Through the general equalizing influence upon the nervous functions which characterizes this class of medicines, it acts very happily in a great number of slight nervous derangements and vascular irritations. It is, however, only in slight affections that it acts on this principle; for, when given in doses calculated to produce an energetic impression, it ceases to be a mere general nervous stimulant, and concentrates its direct action mainly upon the brain. General or local uneasiness, restlessness, moderate wakefulness, slight pains and spasms, nausea, etc., are illustrative examples.

3 *As a Special Stimulant of the Brain.* The indication founded on this property of opium is highly important. Not a few disorders consist essentially in a depressed or debilitated condition of the cerebral nervous

centres; and it is often important to be able to apply to these centres a stimulant, which shall not also materially excite the circulation. Thus, in the collapse sometimes attendant upon the cold stage of fevers, there is not unfrequently vast depression of the nervous centres; yet, as high febrile reaction may soon supervene, the indication is very obvious for a medicine which, while it may rouse the depressed centres, and for a time may stimulate the heart, shall cease to produce the latter effect before reaction is established. Exactly such a medicine is opium, the excitant action of which upon the heart, at all times moderate, is comparatively brief, and is not likely in any degree to aggravate the coming fever. It is obvious, however, that, in such cases, the medicine must be given in its full dose, on account not only of the insusceptibility apt to exist, but also of the relative brevity of its stimulant operation on the heart. Delirium tremens, certain conditions of insanity, and various other nervous disorders call for this cerebral stimulation of opium.

The antiperiodic action, which is often strongly evinced by opium, may be considered as dependent directly upon its stimulant operation on the cerebral centres. In all regular periodical diseases, it is highly probable that the paroxysm makes its first approaches through the nervous centres, and that, if anticipated in its attack by a sufficiently strong preoccupation of those centres, it may be warded off, and set aside altogether; and it is a law of these diseases that, if the regularity of the succession be broken, the complaint itself will cease, at least for a time. Now opium, through its stimulant operation upon the cerebrum and medulla oblongata, is capable of effecting the required preoccupation; and, if given so as to be in full action at the time for the expected return of the paroxysm, will often set it aside. The fullest dose of opium is generally required to answer this indication. Not only intermittent fever, but all other regularly intermittent diseases, may very often be interrupted in this way.

4. *As an Indirect Arterial Sedative.* Allusion has been repeatedly made to the diminished frequency of pulse which follows, in a short time, the excitement produced by a full dose of opium. A diminution in its force, also, comes on after a time; and a positive depression of the circulation is thus effected. The larger the quantity of opium taken, the more quickly is this effect produced; and the inference is that, for the fulfilment of the present indication, the medicine should be given in its fullest regular dose. It is in inflammations, and vascular irritations that opium is called for upon this ground. Its first stimulant action, however, is in the way; and it should not be employed until the force of the circulation has been subdued by suitable preliminary measures, or has somewhat subsided in the course of the disease. The opium should also, as a general rule, be associated with some other medicine calculated to modify its stimulant action; and ipecacuanha or tartar emetic is

usually selected for the purpose. The diaphoretic tendency of such a combination, independently of the depressing properties of the adjuvant, contributes much to the desired object.

5. *As an Indirect Nervous Sedative.* For its action in this way opium is indicated in all kinds of disorder throughout the system, which consists in or depends on nervous irritation. When the capacity to feel, and the power to act fail in the centres, there must be a corresponding depression of their dependent functions, and an irritated or over-excited state of these functions must be diminished or cease. The particular affections which may thus be relieved or remedied are extremely numerous. They include pain in all its varieties, abnormal special sensations, irregular muscular contraction of all kinds, restlessness, wakefulness, dyspnœa, etc. The most important therapeutic effects, however, may be ranked under the three following heads.

a. *For the Relief of Pain, or the Anodyne Effect.* Opium probably relieves pain by an active congestion of the cerebral centres, which, according to the law already stated, at length diminishes or suppresses their sensorial function, or, in other words, renders them insensible to irritant impressions sent to them from other parts of the body. It is not the condition of the suffering part itself that is modified by the opiate, but mainly that of the corresponding nervous centre or centres. The same relief would be obtained, by cutting off the nervous communication between the centre and the diseased part where the source of the pain may exist. As the congestion, in the degree necessary to the suspension of the sensibility of the centres, comes on only after the symptoms of excitement have subsided, it follows that the anodyne operation of opium cannot be among its first effects; and the fact is, that it is not until after the lapse of a considerable time that the relief from pain is experienced. Neuralgia, inflammation, and cancer, are among the affections in which opium is given to fulfil the present indication. The occasions for its use on this score are almost innumerable; and, if it were capable of no other application, it would be an invaluable remedy. Something more is often gained by the relief of pain than a mere abatement of the sufferings of the patient. The affection is itself injurious to health, disturbs all the functions, interferes with sleep, and may even, if continued, destroy life. Opium, therefore, must be considered as not only palliative, but frequently also as remedial, even in its relation to pain alone.

In cases of severe injury, as of a compound fracture, lacerated gunshot wound, etc., the relief afforded by opium, and the support which it yields to the nervous system, are often so great as to spare the necessity of amputation, and thus to save a limb, if not life itself, on the battlefield. (J. J. Chisholm, *Lancet*, July 7, 1866, p. 14.)

b. *For the Relief of Spasm or Irregular Muscular Contraction.* Spasm is of two kinds, that attended with severe pain commonly called cramp, and that which occurs with little pain or none whatever, as in convulsions. The observations in relation to the anodyne operation of opium apply to cramps so far as the relief of pain is concerned. But it does not follow that the spasmodic contraction should be relieved at the same time with the pain. The probability is that the spasm, in all cases in which the involuntary muscles, and often where the voluntary muscles are concerned, depends upon impressions made, not through the cerebral, but the spinal or ganglionic centres; as in spasm of the stomach, bowels, etc., and in tetanus. Now opium, though it acts on the nervous centres of organic life, does so less powerfully than on the cerebral; and it might be expected to relieve the pain more readily than the spasm, and sometimes the former without the latter; and this is really the case. Nevertheless, it has the effect of relaxing the muscular contraction in very many instances, and is among the most efficient remedies in painful spasms. Larger doses, however, are in general required for this condition than either for pain, or for convulsive movements of cerebral origin, as might be anticipated from the less influence of opium over the spinal and ganglionic than the cerebral centres. Thus, spasm of the stomach demands larger doses of opium than gastrodynia; and tetanus often ten times the quantity that would be required to relieve severe rheumatic pain, in the same muscles.

The relaxation of the involuntary muscular contraction produced through the cerebral centres, as in subsultus tendinum, and various convulsive affections, is probably occasioned partly, in the same manner as the relief of pain, by the diminution of the susceptibility of the cerebral centres through which the irritant cause acts, and partly by the diminished power of action in the centres, which prevents them from transmitting to the muscles the influence that induces contraction.

c. *For the Production of Sleep.* To *produce sleep* is another most important indication, which opium is capable of fulfilling beyond all other medicines. It may do this in two modes altogether distinct. When wakefulness is caused by some slight nervous disorder, as not unfrequently happens, small doses of opium, acting in this respect, as a mere nervous stimulant, like assafetida or Hoffmann's anodyne, occasion sleep by simply relieving this disorder. The patient goes to sleep naturally, because he is not kept awake; and the dose of opium, requisite for this effect, would not exercise the slightest soporific influence upon a person in health. This is not, however, the method of producing sleep to which reference is made at present. The soporific action, now under consideration, is the result of a direct influence of the narcotic upon the brain, and is another example of the indirect sedative influence of opium. The sensorial centres are more deeply congested, under the stimulation of the medicine, than is consistent with the performance of their functions, which are for a time nearly or quite suspended. The capacity to feel, to think, and to act, is alike impaired or suspended; though the spinal centres and those of the medulla oblongata still operate. This condition constitutes sleep. It is a higher degree of the same condition in which pain is relieved. The centres are rendered insensible to pain; while still susceptible to impressions from the special senses, the memory, and the intellect. A little further congestion; and these latter susceptibilities cease more or less completely, and sleep, more or less complete, takes place.

The loss of rest is, in many instances, a most serious complication of disease, aggravating, and probably rendering fatal, cases which might, but for it, end in recovery. Whenever it is not attended with high vascular excitement or inflammation of the brain, it may almost always be advantageously treated with opium. The full dose of the medicine is usually required; and, in some cases, this must be greatly increased beyond the ordinary amount. In febrile and inflammatory diseases, opium is often indicated in reference to this effect; and in delirium tremens, and certain conditions of insanity, in which obstinate wakefulness is one of the most prominent symptoms, it is the remedy chiefly relied on.

6. *For the Suppression of Morbid Discharges.* It has been stated that opium has a powerful influence in diminishing the secretions, especially those from the mucous membrane and liver. This property serves as the ground of its employment in various diseases, consisting in, or connected with a morbid increase of these secretions. Hence its use in diarrhœa, cholera morbus, and epidemic cholera. A similar, though less reliable influence on the kidneys, renders it sometimes useful in morbid increase of the urinary secretion. It checks also excessive salivation. By an action, probably of an analogous character, it often proves useful in hemorrhages. The precise principle on which opium produces either of these effects, that is, a diminution of the secretions referred to, or of hemorrhage, is not certainly known. But it may be conjecturally ascribed to the same indirect sedative influence over the capillaries, which is exercised over the heart itself, and, indeed, more or less over the whole system, through the over-excited and congested state of the cerebral centres on which it acts.

7. *As a Diaphoretic.* The increase of perspiration produced by opium, especially when combined with ipecacuanha or tartar emetic, is among the most useful of its therapeutic effects. But in this relation, the medicine will be treated of among the diaphoretics.

Not unfrequently several of these indications for the use of opium exist conjointly in the same disease, of which frequent examples will be given when we come to treat of its special applications.

b. *Contraindications to the Use of Opium.*

Opium is contraindicated by a *high state of febrile excitement* with a full strong pulse, by *determination of blood to the head threatening apoplexy*, by *hemorrhage in the brain*, by *acute inflammation of the brain and its meninges*, and in the *early stage of all acute inflammations with a strong pulse, before sufficient preliminary reduction.* Its direct stimulant properties render it inapplicable to conditions of high vascular excitement in general; and its special action on the brain, to those most emphatically, in which the cerebral centres are already actively congested.

Another special contraindication is *acute inflammation of the mucous membranes*, particularly *that of the bronchial tubes*, before secretion has become established. Here there is risk that its property of checking the secretion from these membranes may tend to aggravate the inflammation, by interfering with the process which nature has intended for the cure.

Nor should opium in general be given in *parenchymatous hepatitis*, in consequence of its strong influence in arresting the secretion of bile, and thus locking up the disease in the substance of the gland.

Excessive sweating, constipation of the bowels, a feeble digestion and want of appetite, and *defective biliary secretion*, are all more or less in opposition to the use of opium; but, when the indications for its use are decided, they should not be allowed to interfere; as means may be readily found to correct its ill effects in these conditions.

I think I have observed that opium sometimes aggravates *cutaneous eruptions*, through the direction which it frequently gives of irritation to the surface of the body.

We have been cautioned in relation to the use of opium in nursing and pregnant women, under the apprehension that, in the former, the impregnation of the milk with its active matter might prove injurious to the infant, and, in the latter, that the drug might prove poisonous to the fœtus. I have myself noticed neither of these effects; but do not wish by this statement to invalidate the caution urged by others.

c. *Special Therapeutic Applications.*

1. *Idiopathic Fevers.* Several indications for the use of opium are offered in different varieties and conditions of fever. As a stimulant it is very useful in the low or typhoid state of fever, when the pulse is feeble, and the blood impaired. Not only is the circulation weak, but the cerebral centres also, in consequence either of the depressing effect of the cause, or of the depraved blood. Stupor or delirium does not, in these cases, constitute a contraindication, when the low muttering character of the latter, and the capability of being roused from the former, taken in connection with the general condition of the system, show that the

brain is suffering rather from debility than from over-excitement. Indeed, opium, by stimulating the cerebral centres, often operates favourably in relieving the two conditions referred to. The tremors, subsultus tendinum, general uneasiness, occasional wakefulness, and other nervous disorder afford other indications for the use of opium, which is, in fact, among our best remedies in the *typhoid condition of fever*. By this expression I do not wish to designate a special febrile disease, as typhus or enteric fever, though these afford the best characterized type of the condition; but a peculiar state of febrile disease, which may attend any one of the idiopathic, and, indeed, even of the symptomatic fevers, and may be known, wherever it exists, by a feeble pulse, dryness and darkness of the tongue or a tendency to them, a dusky hue of the surface, and more or less of the nervous derangements just mentioned. It is seldom met with at the commencement of the special fever which it accompanies; and opium, therefore, is not usually indicated at that stage. The medicine may be combined with ipecacuanha when the skin is dry; and a little blue mass may often be added to the two, with a view to its stimulant influence on the various secretions. They should all be given, as a general rule, in these cases, in small doses frequently repeated. A favourite combination of my own, under these circumstances, consists of one-sixth of a grain of opium, the same quantity of ipecacuanha, and half a grain, or a grain of the mercurial pill, to be given every two hours. This is especially adapted to the condition as it occurs in enteric or typhoid fever. When opium, in cases of this character, increases stupor, delirium, heat of skin, dryness of mouth, or frequency of pulse, it is acting injuriously, and should be omitted. But when it quiets delirium, gives a disposition to natural sleep, lessens the frequency but increases the fulness and force of pulse, and moistens the skin, it is acting beneficially, and should be persevered in.

Without having the typhoid character, fevers are not unfrequently attended with *nervous disorder*, such as twitchings of the muscles, sudden startings, general uneasiness, restlessness, want of sleep, and sometimes slight delirium, which will often yield to a full dose of opium, with an equal quantity of ipecacuanha, or a proportionate amount of tartar emetic, given at bedtime. But, in determining as to the propriety of administering it in such cases, reference should always be had to the contraindications mentioned in *page* 736.

There is another condition of fever in which opium is strongly indicated, with a view to its stimulant influence, especially on the cerebral centres. I allude to the *cold stage at the commencement of fevers*, when it assumes a violent character, either simply of collapse, or of this with intense disturbance of the functions. Such a condition characterizes the onset of *pernicious miasmatic fever;* but it is also not unfrequently met with in other malignant fevers, as in *malignant typhus, yellow fever,* *smallpox*, *erysipelas*, etc.; and, in a less degree, in febrile diseases not malignant. In the *chill of common intermittent fever*, the depression is often so great and so lasting as to call for the same treatment. In all these cases, the original depression is in the nervous centres. It is through them that the cause of the fever first acts, and, prostrating them by its shock, produces the general prostration as a secondary result. Opium is obviously indicated by its highly stimulant action upon these centres; and is preferable to alcohol, because the excitement of the circulation which it produces is sooner over, and does not, therefore, continue forward into the stage of reaction, as the alcoholic stimulation does. Ardent spirits might equally excite the nervous centres, though even in this respect their operation is less favourable than that of opium; but they also endanger an increase of the fever to follow, which opium, properly used, does not. The latter medicine is, indeed, of the utmost importance in the condition now under consideration, and perhaps, on the whole, superior to all other remedies. It should always be given in full doses, being quite inadequate to the desired effect in small quantities. The only contraindication is an active congestion or inflammation of the brain; but, happily, this is comparatively rare under the circumstances referred to. In doubtful cases, great contraction of the pupil might add some weight to that of other symptoms marking the contraindicating condition of the brain; but alone it is of little value.

Still another condition common in fevers, and indicating the use of opium, is *sickness at the stomach*. When this does not depend on acute gastric inflammation, it will often yield promptly to opium or its preparations, administered by the mouth, the rectum, or endermically at the epigastrium.

The special fevers occasionally offer special indications for opium besides those mentioned. Thus, it is often useful in the *enteric* or *typhoid fever*, by putting a check to exhausting diarrhœa, and aiding in the suppression of hemorrhage from the bowels in the advanced stage.

In *smallpox* it is very serviceable in the stage of maturation, and subsequently by moderating the irritative reaction of the disease of the surface upon the system generally. This it does by diminishing the susceptibility of the nervous centres, and consequently their power of receiving impressions from the surface, and transmitting them, in the form of irritation, to the heart, lungs, etc. The same remark is applicable to *erysipelas;* but caution is more necessary in this affection, not to aggravate any existing disposition to cerebral congestion.

In *intermittent fevers*, opium will often effect cures, and may be very beneficially resorted to in the absence of quinia, or as an adjuvant to that medicine. To be most efficient, it must be given in the intermission, and so that it shall be in full action at the time of the expected return of the paroxysm. Its operation is strictly antiperiodic, and has already been explained under the indications for the use of opium. (See *page* 782.) Somewhat more than the medium full dose may be given in this case.

2. *Inflammations.* Much apprehension has been entertained of the effects of opium in acute inflammations. The medicine is a stimulant; inflammation is essentially a state of over-excitement; and the two have consequently been by some considered as almost incompatible. But the fact is otherwise. Experience has shown that opium is a highly useful remedy, when properly administered, in acute inflammations. In certain cases, given in full dose, at the *very first approach* of the disease, it will often set it aside entirely, especially if taken with ipecacuanha at bedtime, and aided in its operation by draughts of some warm tea, as the infusion of balm. It seems to preoccupy the nervous centres so as to arrest the irritant influence of the cause, while it carries off the morbid tendencies through the skin, by its diaphoretic action. The special inflammations in which opium is most efficient in this way are those of the respiratory passages, as *coryza, angina,* and *bronchitis*, and *different forms of rheumatism*, particularly the *subacute*. There is sometimes, however, danger, if it should fail of its effects, that it may somewhat aggravate the affection; and the method is not generally advisable.

After the inflammation has become established, especially if it is severe, opium is at first, in general, contraindicated. Its stimulating properties are as yet in too strong contrast with the wants of the disease. Before commencing with it, the activity, both of the inflammatory action and of the attendant fever, should, in general, be reduced by depletory methods, as by purgatives, the lancet, the antimonials, etc ; but, at the end of two or three days, a sufficient reduction may ordinarily be accomplished, sometimes even sooner, and the opiate be safely administered.

It operates very usefully in various ways. *In the first place*, it alleviates pain, thereby preventing the injurious reaction of that morbid condition on the system, as well as diminishing the sufferings of the patient. But the practitioner must take care not to mistake the relief thus obtained for a positive amendment, or he may be led into serious practical error. He must learn to estimate the real state of the inflammation by other symptoms than the pain. *In the second place*, opium enables the patient to sleep, and obviates the exhausting effects of long wakefulness upon the resources of the system, and its direct injury to the brain. But, *thirdly*, it is still more influential for good, by reducing at once the inflammation and the febrile excitement, through its indirect sedative action. In the inflamed part, the nervous constituent suffers irritation as well as the vascular; and the former, reacting on the latter, aids in sustaining the excitement in the vessels, and the consequent inflammatory phenomena. This property of the nerves, when irritated, to propagate irritation to the blood-vessels, is obvious even in pure neuralgia. In this affection, though the seat of pain may be at first colourless, it soon evinces signs of vascular congestion, by redness, heat, etc. Hence, in cases of inflammation, if we can diminish the nervous irritation in the part, we diminish also the inflammatory action. Opium produces this effect under the same circumstances as those in which it relieves pain, and through the same influence. Again, the local disease produces fever, partly at least, if not exclusively, by operating on the system at large through the nervous centres. If these are rendered obtuse or insensible, so as not to be susceptible to impression from the inflamed part, the reaction on the system must be diminished, and more or less in the same proportion. In this way opium has a tendency to lessen the fever in inflammation, and, as the fever reacts again on the local disease, to diminish that also.

But, to do good in inflammation, the medicine must be given in full doses, so as to act energetically as an indirect sedative. The plan which I generally pursue in acute inflammation is, after sufficient depletion, which may usually be effected in two or three days, to give opium at bedtime, combined with ipecacuanha and calomel, in a dose large enough to put the patient to sleep. Two grains of opium, two of ipecacuanha, and from two to four of calomel may be made into four pills, two to be given at once, a third at the end of an hour, if sleep is not produced, and the fourth at the end of another hour, in a similar contingency. This plan may be continued regularly till no longer required; the bowels being opened daily. The basis of a mercurial treatment is thus laid, which, if deemed advisable from the threatening character of the inflammation, may be carried into effect about the fifth or seventh day, by giving two of the pills every six or eight hours, or one at half the interval, till the gums are touched. The opiate should be gradually withdrawn when no longer needed; so that, when the patient has quite recovered, the want of it may not be felt. Inflammation occurring in different organs requires some modification of this treatment.

In *acute gastritis*, the opium and calomel should generally be given without the ipecacuanha, which is apt to occasion nausea.

In severe cases of *enteritis* and *dysentery*, the above treatment is specially useful; anodyne enemata being additionally employed in the latter affection, when found upon trial to allay the tenesmus. In *dysentery*, opium has by some been considered as contraindicated, in consequence of its constipating effects; but experience has not confirmed these apprehensions. It is, indeed, if properly timed and used, one of the most effectual remedies in that complaint, especially when combined as above recommended. It relieves the spasmodic pains of the complaint, and does not interfere with the action of cathartics, but probably rather facilitates it. But the caution must be observed of keeping the bowels duly open during the day.

In *peritonitis* opium and calomel are invaluable, when further depletion is out of the question, and in cases which will not admit of depletion at all. In the *peritonitis from perforation of the bowels,* opium is the only remedy upon which reliance can be placed. In the *same affection, without perforation, occurring in the course of low febrile diseases,* or attended from the beginning with the same condition of system, the opiate plan with mercury should be commenced immediately after a thorough evacuation of the bowels; the opium being freely administered, and the bowels afterwards left undisturbed, except by the occasional exhibition of a cathartic enema, to evacuate the rectum and lower colon. Prof. A. Clark, of New York, has found large doses of opium the most effectual remedy in puerperal fever, when peritonitis is "a prominent element" in the disease. (*New York Journ. of Med*, March, 1855.)

In *hepatitis,* opium should be used with more reserve, in consequence of its property of checking the secretion of bile. Still, if it be combined with calomel, this effect may be in a considerable degree obviated; and I should not hesitate to employ it, if necessary to procure sleep. It is, however, better adapted to those cases in which the investing membrane is affected. In the parenchymatous inflammation of the gland, it would be best, on the whole, not to use it; and as the pain is in this case less severe, there is not the same occasion for its use.

In *inflammations of the internal urinary and genital organs,* the general rule as to the use of opium holds good; but, as the stomach is very apt to be irritable in nephritis, it is often necessary to omit the ipecacuanha; and, in all these cases, the opiate is in general most efficaciously administered by enema.

All the inflammatory affections of the chest, whether of the respiratory or circulatory organs, come under the general rule, with the exception of the different forms of *acute bronchitis,* in which opium should ordinarily not be given until secretion has been thoroughly established; as it tends to prevent this result, and thus to increase the pectoral oppression, and to aggravate the disease. But, when the acuteness of the inflammation has been subdued, and expectoration has become free, opium in moderate doses is often very useful, in connection with expectorants, in relieving the harassing cough, and enabling the patient to rest. The same rule applies also to the chronic form of the complaint.

After what has been already stated, under the head of contraindications to the use of opium, it is scarcely necessary to repeat that it is altogether unsuitable to the treatment of *acute inflammation of the brain,* and of very doubtful advantage even in the *chronic;* though cases sometimes occur, in which, from the particular seat of the affection, as, for example, when confined exclusively to the meninges, the indications for its use more than balance the contraindications. To procure rest is sometimes, under these circumstances, all-important; and opium may be cautiously used, when no symptoms of acuteness in the inflammation are present.

In *erysipelatous inflammation* of the skin, opium may be given when not forbidden by stupor or coma.

But of all the inflammatory affections there is no one to which it is better adapted than *acute rheumatism*. After two or three days given to depletory measures, opium and ipecacuanha, or the Dover's powder, may be used very freely; and, if associated with calomel, so as to affect the system in the course of the second week, will in general be found adequate to the cure. In *subacute rheumatism*, the remedy is indicated from the commencement; and, in the *chronic form*, a Dover's powder at bedtime may enter into almost every plan of treatment adopted in that complaint.

In *acute gout*, too, it is highly useful at bedtime, in relieving pain and enabling the patient to sleep, and, so far as I have seen, does no harm. It is, however, in this complaint better associated with colchicum; and the mercurial addition is not advisable unless merely to stimulate the liver when torpid.

In the *suppurative stage* of inflammation, opium, in moderate stimulant doses, is of great use in supporting the system, and comforting the patient; and should generally be given with the tonics and stimulants employed.

Ulceration, when painful, and indisposed to the healing process in consequence of an irritated condition, connected, it may be, with an irritable state of the system at large, may be advantageously treated with opium, both given internally, and applied topically. M. Rodet has derived great advantage from it in the *phagedenic serpiginous ulcerations* of syphilis, in which mercury is altogether contraindicated. (*Med. Times and Gaz.*, Aug. 1856, p. 176.) Mr. Skey, of St. Bartholomew's Hospital, London, considers no treatment equal to the opiate, in very old and obstinate ulcers of the limbs or other parts, in which it seems to act with a restorative power, wholly independent of its mere sedative influence. (*Ranking's Abstract*, No. xxiii. p. 120.)

When inflammation is attended with *gangrene*, opium is an invaluable remedy, relieving the pain often attendant on that affection, and supporting the nervous centres under its prostrating influence. Indeed, opium is indicated in *mortification* under almost any circumstances; and, in the last stage of acute inflammation of the alimentary canal, given in combination with oil of turpentine, it affords, in some instances, almost the only remaining chance for the patient.

After all that has been stated above, I wish not to be understood, as recommending opium in all cases of inflammation, when no positive contraindication may exist. In slight or even moderate cases, and in the chronic forms generally, it should be employed with great caution, from the fear of leading the patient into its habitual and excessive use.

3. *Vascular Irritation.* In this condition, opium is often of great advantage, by diminishing the susceptibility of the nervous tissue of the part, and of the nervous centres, and thus obviating their injurious reaction upon the vascular tissue and the heart.

In *nausea and vomiting* from this cause, it is an admirable remedy, applied either by the stomach, the rectum, or endermically to the epigastrium; the two latter methods being resorted to, severally or conjointly, upon failure with the first. The subcutaneous exhibition also of the medicine is strongly indicated under these circumstances.

When any medicine has a tendency to irritate the stomach, this may generally be corrected by conjoining the medicine with a little opium, which is very much used for the purpose, and may always be employed unless when specially contraindicated. Thus, it may be given with nitrate of silver in chronic gastritis, and sulphate of copper in chronic enteritis; but should not generally be exhibited with cathartics, which it tends to counteract, nor with tonics in dyspepsia, because it rather weakens than invigorates the digestive function.

In *slight diarrhœas*, resulting from vascular irritation, opium is often the only remedy required, when there is no indication for evacuating the bowels; and, when such an indication is offered by the presence of irritating matters, no remedy is so promptly effectual as fifteen or twenty drops of laudanum with a full dose of castor oil. In *acrid poisoning*, after the evacuation of the irritating agent both from the stomach and bowels, opium is the chief remedy required; and it may often be used advantageously in connection with the special antidote of the poison. *Emetics* and *acrid cathartics* frequently leave an irritation behind them, which is promptly relieved by opiates either by the stomach or the rectum. In *irritations of the urinary and genital organs* they are no less promptly useful, and often afford almost instant relief to great distress, as, for example, in the *strangury from blisters*. In these affections, the opium is most effectual when given by injection, or used as a suppository.

4. *Nervous irritation.* This exhibits itself in a great diversity of forms, which require a separate consideration.

Neuralgic pain is among the most frequent. Wherever this occurs, and under whatever name, opium is at least a most efficient palliative, sometimes absolutely indispensable from the suffering of the patient. Not unfrequently it will set the disease aside entirely for the time, especially when occurring periodically. Given so as fully to affect the system, it will often wholly supersede the paroxysm, and by thus breaking the chain of morbid association, effect at least a temporary cure. The quantity necessary to produce relief varies greatly with the violence of the pain, and the constitutional susceptibility of the patient. Sometimes an ordinary full dose will answer; but it will often be found necessary to double, triple, or quadruple it, before relief can be procured. When local application will answer the purpose, it should be preferred, as interfering less with the functions of the stomach and bowels. With the skin unbroken, little effect can generally be obtained; but, by means of the endermic method, or by injection into the subcutaneous areolar tissue, the medicine may generally be used with prompt and powerful effect, in the form of one of the salts of morphia. Not unfrequently a specially tender spot may be discovered in the track of the nervous trunk, supplying the painful part. In this case, the remedy should be applied to the point of tenderness; the cuticle having been first removed by a blister. But a great objection to the use of opium in neuralgia is the increasing dose in which it must be successively employed in order to procure relief, and the consequent danger of augmenting the quantity indefinitely, until the effects of the remedy become almost as pernicious as the disease itself. This objection applies especially to cases in which the affection is incessant in its attacks, and probably incurable. Yet the patient will seldom submit to severe suffering, when an agent of present relief is at hand; and the duty of the physician is so to regulate the remedy as to obviate its ill, and protract its beneficial effects as far as possible. This is to be done by allowing the dose to be increased only when absolutely necessary; by varying the surface of application between the stomach, the rectum, the skin, and the areolar tissue; by occasionally intermitting the use of the medicine, and endeavouring to obtain a similar effect by anodynes acting on different principles, as by chloroform or conium; and by correcting any resulting disorder of the functions by proper means, as constipation by laxatives, deficient action of the liver by mild mercurials or nitromuriatic acid, and enfeebled digestion by tonics, taking care not to do injury by the excessive use of the counteracting measures. By this plan, in incurable cases, the patient may be rendered more comfortable, and his life prolonged; whereas, if left to his own unrestrained propensities, he might soon exhaust the susceptibility of his system, and thus render the remedy almost useless.

Even in occasional attacks of neuralgia, occurring at considerable intervals, the physician should always bear in mind the danger of laying the foundation of an evil habit, and should guard the use of opiates with such precautions as may tend to obviate this result. Sometimes, in persons of feeble intelligence, or deficient power of self-control, it may be proper to disguise the medicine, so that the patient may not know what he is taking; and generally it is best to confine the use of opium, when the recurrence of the pain is frequent, to the severest attacks.

Besides the external attacks of neuralgia, which may occur in any sensitive part of the body, from the crown of the head to the joints of the great toe, there are various internal forms of it, which are sometimes even more imperious in their demands for relief, as *angina pectoris*, *gastralgia*, *enteralgia*, *nephralgia*, and *dysmenorrhœa*, the last of which is, I believe, often nothing but a neuralgic form of rheumatism, and may be most effectually relieved by this anodyne given by the rectum. In nervous *toothache* and *earache*, opium may often be applied locally with effect; being introduced into a carious cavity, should a cavity exist, in the former case, and in a liquid form into the meatus externus, in the latter.

Neuralgia is often nothing more than a form of *nervous gout* or *rheumatism*, in which cases the opiate may be associated with the wine or extract of colchicum, and frequently also advantageously with a saline cathartic.

Nervous headache, or *sick-headache*, will often yield happily to a full dose of opium or morphia, which is most effectual, however, in the latter affection, when it perseveres, after evacuation of the stomach. But care must be taken not to confound this complaint with headache from vascular irritation, or active congestion of the brain.

In *cancerous affections* it is often necessary to have recourse to anodynes; and the observations above made, in relation to the precautions necessary to guard against the abuse of the medicine in incurable neuralgia, and to obtain the greatest amount of good from it, are equally applicable to this case.

The same remark may be made of *aneurisms* and all other *tumours*, which, though not painful in themselves, often become extremely so by pressure on the trunks of neighbouring nerves, or in other modes interfering with the healthy structure near them.

Painful spasms afford still stronger indications for the use of opium than simple neuralgia, because often more dangerous in their consequences, and because, also, being only occasional, and generally occurring at distant intervals, there is less danger of an abuse of the remedy. These spasms may be either external, affecting the voluntary muscles, or internal, affecting the muscles of organic life. Of the former we have examples in *ordinary cramps of the limbs*, in the intensely painful *cramps of cholera*, and in *tetanus*. It is in the two latter affections chiefly that opium is used; and in both it is certainly among the most efficient remedies. In tetanus, the insusceptibility of the cerebral centres is such, that much larger doses are required than under ordinary circumstances. Two grains may be given at first every two hours, and, if necessary to bring about relief, the dose may be increased to four, five, or six grains, or an equivalent proportion of morphia or one of the liquid preparations, repeated as often, until some degree of narcotic effect is experienced; but the quantity of half a drachm of opium in twelve hours should in no case, I think, be exceeded; as, if the disease should suddenly give way, poisonous effects might ensue from the portion remaining unabsorbed in the stomach. The internal painful spasms are those of the *stomach*, of the bowels in the different forms of *colic*, of the *ureters* and *ducts of the liver* from the passage of calculi, of the *bladder*, of the *uterus*, and finally of the *diaphragm* and the *heart*. In all these affections the pain is often exquisitely severe, and in some of them life is endangered by the continuance of the spasm. All of them afford the clearest indications for the use of opium, which may in general be given unhesitatingly, and in quantities requisite to obtain relief, beginning with a full dose, and increasing until the pain is alleviated, or narcotic effects induced. The same insusceptibility to the influence of the anodyne exists as in tetanus, though usually in a much less degree; and it is seldom necessary to exceed two grains of opium, or an equivalent quantity of its preparations, at one dose. The liquid preparations are preferable to solid opium, as they operate more speedily. In these several affections, it is necessary to combine special modes of treatment with the anodyne, which, however, this is not the proper place to detail. As examples, it may be mentioned that, in gouty spasm of the stomach, colchicum may be combined with the opiate; in ordinary colic, castor oil; in bilious colic, calomel; in spasm of the heart or diaphragm, ether or chloroform; in spasm of the hepatic ducts, ether and oil of turpentine; in that of the ureters, the alkaline bicarbonates; that in all of them sinapisms and the warm bath are efficient adjuvants; and that, when not contraindicated by debility, the lancet may often be used with powerful effect in producing relaxation. The spasmodic pain attending enteritis, cholera, dysentery, and peritonitis, affords an indication for the use of opium; but those founded on other effects than the merely anodyne are much more important.

Various spasmodic and convulsive affections, not painful in their character, or but slightly so, belong to the category of nervous irritations, and are more or less benefited by opium. Such is the *paroxysm of spasmodic asthma*, in which opium will often afford relief, though it is liable to the objection of checking bronchial secretion, and is, on the whole, much less efficient than some other narcotics and nervous stimulants or sedatives. In *epilepsy* it may sometimes be used as a palliative; but, on the whole, is better avoided, both from its liability to abuse, and from its congestive influence on the brain. In *hooping-cough* it is liable to the same objection as in asthma, and should be used only as a palliative of the cough, in connection with expectorants. To *chorea* it is scarcely appropriate, unless to obviate occasional intercurrent affections. In the various spasmodic affections of *hysteria* it is for a time an almost sovereign remedy; but, on moral grounds, requires to be prescribed with caution. In the *convulsions of infants*, depending on intestinal spasm, opium is an excellent adjuvant of other remedies.

To the list of nervous irritations relieved by opium may be added *obstinate wakefulness, general uneasiness, restlessness, languor and faintness, palpitations, nervous cough*, and all the protean derangements of *hysteria;* but, as a general rule, it is better to seek relief, in these affections, when not associated with other serious diseases, from remedies less accordant with the propensities of our nature, and less liable to abuse.

5. *Nervous Depression.* In affections of this nature, the stimulant influence of opium on the nervous system renders it peculiarly efficacious. Perhaps under this head we might rank the collapse of the initial stage or chill of certain febrile diseases; but enough has been said on that subject already.

Insanity often presents conditions in which this influence of opium is extremely useful.

There is a species of *delirium* resulting from extreme fatigue, long watching, exhausting indulgences, excessive study, etc., for which this is the most efficient remedy, combined with measures calculated to restore strength. Such attacks of delirium occasionally supervene upon acute diseases, especially those of a febrile character, and are very liable to be mistakenly ascribed to active congestion or irritation of the brain. I have seen it occur in acute rheumatism, and cause serious apprehensions of rheumatic meningitis. I have also seen such a condition occur in erysipelas, with a sudden disappearance of the local inflammation, and with signs of great prostration. The relief obtained, in all such cases, from full doses of opium, is a sufficient proof of their nature. It is usually advisable to combine the opium with ipecacuanha, so as to modify its stimulant effect, should the diagnosis prove to have been erroneous.

Delirium tremens is an example of the same condition of the brain, induced in drunkards by the abstraction of their wonted stimulus. In this affection, I regard opium as the most valuable remedy in our possession. Given in the dose of about two grains, repeated every two hours, it will almost always, in the uncomplicated cases, induce sleep from which the patient will awake improved, if not quite cured. Sometimes two or three days may elapse before the effect is produced; but no injury results, if the opium is withheld upon the first occurrence of narcotic symptoms. It is seldom necessary to exceed the amount stated. Injurious cerebral effects have been ascribed to the use of opium in delirium tremens; but I have not seen them, though much of the disease has come under my notice. Where they have occurred, I presume that the meningitis of drunkards has been mistaken for pure delirium tremens; a mistake which may be readily made, as the symptoms of the latter disease are almost always, and necessarily intermingled with it. But, while the opium is given as the main remedy, sufficient alcoholic drink should be administered to prevent prostration. I have seen death result apparently from a neglect of this precaution.

Most of the affections already referred to, as the result of nervous irritation, may proceed also from debility or depression of the nervous centres; and, as the former yield to the indirect sedative property of opium, so do the latter to its direct stimulant action. *Muscular tremors, spasmodic and convulsive affections, wakefulness, general uneasiness, restlessness, depression of spirits, palpitation of the heart, dyspnœa, various abnormal sounds* and *visual disorders, vertigo,* and *headache,* are some of the affections referred to. As a proof that they are really the effects of weakness or depression, they come on frequently as the direct consequences of a debilitated state of system, as in convalescence from exhausting diseases, after hemorrhages or copious bleeding, and under the direct influence of sedative poisons, as tobacco and hydrocyanic acid. They generally yield, at least temporarily, to moderate doses of opium.

6. *Morbid Discharges.* In these affections opium is one of the most efficient means employed, and, whatever other remedies may be used, is very often combined with them. It probably operates, through its indirect sedative agency, in allaying irritation in the part affected, and diminishing the activity of the capillaries. The morbid discharges are either, in the first place, secretory or excretory, or secondly, hemorrhagic. To the first category belong diarrhœa, the different forms of cholera, diuresis and diabetes, gastrorrhœa, cystirrhœa, bronchorrhœa, and ptyalism.

In *diarrhœa* and *cholera* opium acts not only by restraining secretion, but also by diminishing the activity of the peristaltic movement, probably through a sedative agency in relation to the organic nervous centres. Of its use in diarrhœa dependent on acute inflammation or vascular irritation of the alimentary mucous membrane enough has been said already. But there is no form of that affection in which it may not be usefully employed, except, simply, in cases in which the affection is acting beneficially, either by diverting disease from some part where it might do more harm, relieving plethora, or promoting the absorption of effused fluid, as in dropsy. In all these cases, opium may prove injurious by prematurely arresting the discharge, and should be resorted to only to regulate the amount of it, and to control it when likely to do more injury by exhausting the patient, than good in either of the modes mentioned. In *bilious diarrhœa,* it acts upon the liver as well as on the bowels; but in general should not be used alone, as the excess of the bilious secretion is probably relieving hepatic congestion, and its suppression might endanger an attack of hepatitis. Under such circumstances, it should always be associated with small doses of calomel, which, while the opium restrains the secretory function of the liver, has the effect of preventing its entire suspension, and, at the same time, acts as an alterative upon the gland. The best method of administering the two remedies, in this affection, is to give very small doses of each, very frequently repeated; so that their operation may not be too powerful at once, and may be more conveniently watched, and timely checked, if desirable. One-sixth of a grain of each may be given every hour or two, till the desired effect is produced, or a grain or two have been administered; and it is often a good plan to intermit the treatment every other day, resorting, in the intermediate day, if the discharges have been arrested, to a mild laxative. In the *diarrhœa attended with copious light-coloured discharges*, which are sometimes very profuse and exhausting, opium is equally indicated as in the former case; and there is a still stronger call for the conjoint use of calomel, in order to restore the hepatic function, and thus unload the portal veins through their natural outlet. In *chronic diarrhœas*, whether dependent on relaxation, mere habit, or chronic inflammation or ulceration, opium in small doses, though it cannot be depended on for the cure, is an almost essential adjuvant of the astringents and alteratives employed; and, in full dose, combined with ipecacuanha at night, operates very usefully by superadding to its direct influence on the peristaltic movement a revulsive influence towards the surface.

In *cholera*, opium is no less efficient. The ordinary bilious cholera, or *cholera morbus*, may be treated with it in the manner above recommended for bilious diarrhœa; the two diseases being, in fact, identical in character. But the dose should be more frequently repeated, as often as every half hour till relief is obtained; and, when the pains are very severe, and the discharges exhausting, the opiate should be considerably increased, and administered by enema if rejected from the stomach; calomel being at the same time moderately exhibited as before, to guard against a total suspension of the hepatic secretion. The discharges of bile in cholera morbus are no doubt intended to relieve a congestive irritation of the liver and whole portal circulation, which without this outlet might end in serious inflammation or fever. The use of calomel ensures a sufficient action of the liver to prevent ultimate evil, while the opium prevents immediate mischief by arresting the excessive discharge.

Epidemic cholera I believe to be a different affection from ordinary cholera morbus, and to depend on a different cause. Nevertheless, there is the same indication for the combined use of opium and calomel. In the stage of diarrhœa, or the joint discharge from the stomach and bowels called cholerine, which generally precedes the distinctive rice-water evacuations of the fully formed disease, opium is the remedy mainly to be relied on. With or without camphor and the aromatics, and in small doses frequently repeated, it almost always arrests the discharges, and thus probably averts cholera itself. I have usually preferred the ordinary paregoric, or camphorated tincture of opium of the Pharmacopœias, of which a fluidrachm may be given three or four times a day if necessary. Should the evacuations from the bowels be destitute of bile, small doses of calomel and opium should be employed as above advised. Sometimes it may be necessary to give the opiate more largely, and to combine with it an anodyne enema, and a sinapism over the abdomen. When the cholera is fully formed, opium is still, I think, the sheet-anchor in this disease. It should now be given in the dose of a grain or two at first, and afterwards repeated at intervals of half an hour or an hour, in one-quarter, or one-half the dose, till the discharges are arrested, and the pains relieved, or till some evidence of narcotism is produced. After this, it is of no use to push its effects further. Indeed, it can do only harm, by aggravating the general prostration through its secondary sedative effects. The great rule is not to allow it to render the patient stupid, or comatose; but, within this point, to continue its use, at longer or shorter intervals, so long as indicated by the spasms and the evacuations. But it should never be relied on exclusively. With the quantity of opium above mentioned, from two to four grains of acetate of lead, and a grain or two of calomel should be given, to be repeated afterwards along with it in proportionately diminished doses. At the same time, an anodyne enema should be exhibited, and a sinapism applied over the whole abdomen; warmth and rubefaction to the extremities being additionally used, if these should be cold and bloodless. In the collapse of cholera, opium is of little or no use. In the stage of reaction, its employment must be governed by the same principles as in low fevers and inflammations.

Cholera infantum does not offer equally strong indications for the use of opium. The head is so apt to suffer in infants, that anything which tends to congest the cerebral centres must be used with caution. Nevertheless, if the vomiting cannot be otherwise restrained, this remedy may be cautiously administered, and should be preferably used by injection; great care being taken to proportion the dose to the age. In the subsequent stages, when the affection has assumed rather the character of diarrhœa, and the indication exists for checking the evacuations, very small doses of opium, or one of its preparations, may be added to the cretaceous, astringent, or alterative medicines employed.

In *excessive secretion of urine* or *diuresis*, especially when connected with nervous disorder, or an irritable state of the system, opium is one of the most efficient remedies. In *diabetes*, strictly so called, it is an excellent palliative, diminishing frequently the amount of excretion, moderating the wear of the system, and greatly comforting the patient; but it is wholly inadequate to the cure. It should be used in this complaint, in full doses, and preferably at night. In small doses, frequently repeated, so as to produce its stimulant effects, I have often known it greatly to increase the secretion of urine.

In *excessive mercurial salivation*, opium is very useful, not only by checking the discharge, but by relieving pain, and diminishing nervous irritability.

In the *excessive mucous secretion from the stomach, bladder,* and *bronchial tubes*, called respectively *gastrorrhœa, cystirrhœa,* and *bron-*

chorrhœa, opium may be usefully employed as an adjuvant or corrective of other medicines; but cannot be relied on exclusively, or even as the chief remedy. Under this head may be mentioned the use of opium in combination with other medicines, where it may be desirable to prevent their operation upon the bowels. For this purpose, it is almost constantly given with calomel, and frequently with the blue mass, when the object is to obtain the peculiar effects of mercury on the system.

Hemorrhages constitute the second division of morbid discharges. In most of these opium is indicated, both from its effects upon the capillaries, and for its influence in quieting various attendant irritations, which often serve to aggravate the main affection. Thus, in *hemorrhage from the lungs*, or *air-passages*, it proves serviceable by allaying the irritative cough, which, by agitating the parts, tends to sustain the bleeding. In *hemorrhage from the stomach*, after the full evacuation of its contents, an irritated condition often remains, which provokes vomiting unnecessarily, and prevents the retention of medicines that may be indicated. Opium by the mouth or rectum, or endermically to the epigastrium, is very useful in such a condition. So also in *hemorrhage from the bowels, bladder*, and *uterus*, it tends to control the irritative movements, which, beyond what may be necessary for the mere evacuation of the effused blood, can act only disadvantageously on the affection. For these purposes, it is usually sufficient to employ small doses, in conjunction with the other medicines indicated. For the direct influence of the opium on the bleeding vessels, it should be given in full doses, and combined with ipecacuanha; the patient being confined to bed, and well though not hotly covered, so as to favour the perspiration which is apt to be induced. But for this purpose, opium is not indicated in all the hemorrhages, nor in all conditions of any one of them. It should not be used when the pulse is full and strong, with a general febrile movement, and an active congestion of the bleeding organ. This condition should be removed by depletory and refrigerant methods, before recourse is had to opium. The remedy, *in full dose*, is of doubtful propriety in any case of hæmoptysis, in consequence of its tending to check bronchial secretion, and thus rather to promote than relieve congestion of the vessels. Nor can it be given, as a general rule, in connection with ipecacuanha in hæmatemesis. But in *intestinal, renal*, and *uterine* hemorrhages, after a suitable preparation of the system, or in cases which have at no time presented any contraindication, it is often an excellent remedy. In *menorrhagia* it is especially useful, and, with rest, will often itself be quite adequate to the cure. In the purely passive hemorrhages, whether dependent on mechanical obstruction, or on that disorganized state of the blood which permits it to ooze out through the unresisting coats of the capillaries, opium can be of little service as a mere hæmostatic. As a stimulant, it may be useful in the conditions of system attendant upon the state of the blood referred to.

6. *Administration.*

The dose of opium varies extremely with the purpose to be fulfilled, the idiosyncrasies and habits of the patient, and the modification of susceptibility produced by disease. For *full anodyne and soporific effect*, the medium dose is one grain. Less than half a grain will seldom produce these effects fully; and more than two grains should very rarely if ever be given, as a commencing dose, to an individual whose peculiar susceptibilities are unknown to the prescriber. For the *pure stimulant effect*, in persons quite unaccustomed to the use of the medicine, and in diseases in which the susceptibility is not impaired, the dose may vary from one-eighth to one-half a grain, which should be repeated, according to the quantity given, every two, four, or six hours, so as to sustain a steady impression. As a mere *nervous stimulant*, in the sense in which that expression is used in this work, to designate, namely, a certain class of medicines, having peculiar properties and applications, the dose is from one-twelfth to one-quarter of a grain. For this purpose, the liquid preparations are generally to be preferred. But it must be remembered, in regulating the dose of opium, that some persons are naturally extremely susceptible, and others perhaps equally insusceptible to its effects; that, under the influence of habit, an individual becomes gradually less and less susceptible, and to an indefinite extent; and, lastly, that, in certain diseases, in which the cerebral centres are vastly depressed, and in others in which the whole energies of the nervous system are concentrated in some violent local affection, the dose required to produce a given effect is greatly augmented, and sometimes almost indefinitely. Among the former affections are delirium tremens, and the collapse at the commencement of certain fevers; among the latter, spasm of the stomach, severe colic, and, above all others, tetanus.

The commencing dose for an *infant at birth*, and for two or three weeks afterwards, should not exceed one-fortieth of a grain; and not more than from one-twentieth to one-tenth of a grain should be given to a child within the year. After this age, the dose may be regulated according to the rule of Dr. Young. (See *pages* 33–4.) The liquid preparations are generally preferable for infants.

Opium, in substance, may be taken in *powder*, *pill*, *lozenge*, or *electuary*. The form of *pill* is almost always preferred. For ordinary purposes, the pill should be made from powdered opium, and should not be kept very long before being used. But, when it is desirable, on any account, that it should operate very slowly, either an old pill, or one made directly from the plastic mass may be employed. The form of *lozenge* is used only when it is desirable that the medicine should be held in the mouth, and allowed slowly to dissolve; so as to act specially on the mouth and fauces, as may sometimes be desirable in coughs.

By *the rectum*, opium is used in the form of a suppository, or in that of an enema. The *suppository* may be made by rubbing the opium up with soap, or with cacao butter, and forming the mass into a cylindrical shape. The dose given by the rectum should not, at first, exceed twice the quantity administered by the mouth. A triple dose has not unfrequently been given, and even more, without injury; but there is thought to be some risk from this larger quantity; at least, effects much greater than were anticipated or desired have sometimes been produced. The dose, then, in this way, at the first trial, may vary from one to four grains. In persons habituated to large doses of opium by the mouth, there might possibly be some danger from giving by the rectum twice the quantity usually taken in the former way. The susceptibility and absorbent power of the rectum may not bear the same relation to those of the stomach as before the habit was acquired. It would be safest, under these circumstances, to begin with a relatively very small dose, and increase, if necessary. For *enema*, one of the liquid preparations should generally be used, and administered in a wineglassful of pure water, or of some mucilaginous or amylaceous liquid, as flax-seed tea or solution of starch. The purposes for which opium is specially employed in this way, are, 1. to affect the system when the stomach will not retain the medicine; 2. to allay irritability of the stomach; 3. to check evacuations from the bowels; and 4. to relieve pain or other irritation in the rectum itself or neighbouring parts, as the genito-urinary apparatus. Thus *strangury, spasm of the ureters, bladder, and urethra, dysmenorrhœa, priapism, chordee*, etc., are more effectually and speedily relieved by opium, when given by the rectum, than by the mouth.

Opium, or one of its liquid preparations, is sometimes injected into the urethra or vagina, to relieve pain or irritation, or suppress discharges. It is also introduced into the cavity of a carious tooth to relieve toothache, and into the external meatus in earache. One of its liquid preparations is not unfrequently dropped into the eye, to allay irritability of the conjunctiva in ophthalmia. In the form of lotion, embrocation, cataplasm, or plaster, it is applied to various parts of the surface, to relieve pain, as in neuralgic affections, gouty and rheumatic pains or swellings, erysipelatous inflammation, various cutaneous eruptions, and irritated ulcers. But caution is always necessary, in these cases, not to use it so largely that, if absorbed, it might produce poisonous effects on the system; and special caution is necessary in infantile cases.

7. *Preparations of Opium.*

These are very numerous, but scarcely more so than desirable, when the great diversity of circumstances is considered under which the medicine is used, the different purposes it is calculated to fulfil, according to the method or form in which it is employed, and the variable idiosyncrasies which require that, if one preparation may not happen to agree with the individual, we may have recourse to another, or to many successively, until one is found to answer.

PILLS OF OPIUM.—PILULÆ OPII. *U. S.*

These are prepared by simply incorporating opium with soap, which answers no other purpose than that of a convenient excipient. Each pill contains a grain of opium.

COMPOUND PILLS OF SOAP.—PILULÆ SAPONIS COMPOSITÆ. *U. S.* —PILULA OPII. *Br.*

In these pills, as in the preceding, there is a mere mixture of opium and soap; but the proportions are so arranged, that five grains of the mass contain one grain of opium. The preparation affords a ready method of obtaining small fractions of a grain of opium, when wanted, as they frequently are, for children. Another advantage is that they may be prescribed, without a knowledge, on the part of the patient, of what has been directed for him. The London College, upon the same grounds, formerly directed the *Compound Pills of Storax*, in which storax and saffron were employed, not only to dilute the opium, but to cover its taste and smell; but the preparation has been omitted in the Br. Pharmacopœia. The proportion of opium was the same as in the U. S. preparation, namely, one grain in five of the mass.

POWDER OF IPECACUANHA AND OPIUM.—PULVIS IPECACUANHÆ ET OPII. *U. S.* 1850.—PULVIS IPECACUANHÆ COMPOSITUS. *U. S.* —*Compound Powder of Ipecacuanha.*—PULVIS IPECACUANHÆ CUM OPIO. *Br.*—*Dover's Powder.*

This is an excellent diaphoretic preparation of opium, but will be more fully treated of with the *diaphoretics*. I do not think that the change in the name of this preparation, made in the recent edition of our Pharmacopœia, was judicious. If made in order that the title might be in accordance with that of the London College, it was unfortunate; for our own old title, essentially, has been adopted in the British code in preference to that of the London Pharmacopœia; and the same discrepancy exists as before.

CONFECTION OF OPIUM.—CONFECTIO OPII. *U. S.*

This is prepared by rubbing opium up with honey and the officinal aromatic powder, consisting of cinnamon, cardamom, and nutmeg. It has the advantage, through the stimulating property of the aromatics, of counteracting the depressing effects of opium upon the digestive function, and may sometimes be received by an irritable stomach, when opium would be rejected. The possession of this property sufficiently indicates the circumstances under which it may be used. It is supposed, when given with Peruvian bark and sulphate of quinia, to increase their efficacy in obstinate intermittents. One grain of opium is contained in about thirty-six grains of the composition; so that it affords a convenient form for prescribing small doses for infants.

EXTRACT OF OPIUM.—Extractum Opii. *U. S.*, *Br.*

This is an aqueous extract of opium, and of course consists exclusively of the principles soluble in water. Opium contains ingredients insoluble in water, which, however, it yields to an alcoholic solvent, either vinous or distilled; and, as these principles may possibly be not without some influence upon the system, the effects of the opium may be somewhat modified in the extract, and different from those obtained from opium itself, its tinctures, or the wine. Hence this preparation is supposed to agree with certain individuals, with whom opium and its other preparations disagree. It has the advantage also of affording a ready means of preparing a solution of the active matter of opium in water, which is sometimes desirable, particularly for application to the eye, and other external inflamed surfaces, and for injection into inflamed or irritated mucous passages, as the rectum, urethra, or vagina, in all of which cases, the stimulant properties of the tincture, derived from the alcohol it contains, are contraindicated. The *dose* is one-half that of opium.

In dysenteric cases, an injection of the extract of opium, dissolved in water, will sometimes be retained, and afford relief, when laudanum would be rejected; and it is not impossible that the same remark may be true of its use in irritable states of the stomach. A solution of the extract, in the proportion of from one-quarter to one-half of a grain to the fluidounce, is sometimes administered in the form of spray, to relieve cough; being thrown into the air-passages by means of the atomizer.

In a former edition of this treatise, it was suggested that an *Elixir of Opium* might be prepared from the watery extract, by treating it with diluted alcohol, using only half as much of the extract in proportion as there is of opium employed in the preparation of the tincture. An elixir thus made would have the same strength as laudanum, and would be destitute of whatever matter, insoluble in water, alcohol may extract from opium. This suggestion has been more than met by the *Deodorized Tincture of Opium* of the present U. S. Pharmacopœia.

OPIUM PLASTER.—Emplastrum Opii. *U. S.*, *Br.*

Opium plaster is made by mixing powdered opium, or still better the extract in half the quantity, with boiling water, incorporating the mixture with melted Burgundy pitch and lead plaster, and then evaporating the moisture. It may be used, spread on leather, as an anodyne application in fixed pains, of a rheumatic character or otherwise.

TINCTURE OF OPIUM.—TINCTURA OPII. *U. S., Br.*—*Laudanum.*—*Thebaic Tincture.*—*Tinctura Thebaica.*

Laudanum is prepared, according to the U. S. Pharmacopœia, by macerating two ounces and a half of powdered opium first, for three days, with a pint of water, then, for three days longer, with the same menstruum increased by the addition of a pint of alcohol; submitting the whole to percolation; and, when the liquid ceases to pass, pouring in diluted alcohol, until two pints of tincture are obtained. When it is properly made, the virtues of the opium may be considered as wholly extracted by the menstruum. The pulverization of the opium ensures the previous drying of the drug, which is important; for crude undried opium always contains water, and often in considerable though variable proportion; and, if it were employed in the process, would render the resulting tincture weaker than the officinal, and of uncertain strength. Happily, though the British process differs somewhat from our own, the resulting tincture is so nearly the same, that the two, for all practical purposes, may be considered as identical. Laudanum should be kept in well-stopped bottles, as the alcohol evaporates on exposure, and the liquid is rendered turbid by the deposition of the dissolved matter. Not unfrequently flakes of solid extract may be seen at the bottom of old laudanum bottles; and it may be readily conceived that, if this should be dropped out with the liquid, the narcotic effects of it would be very greatly increased. Death in infants has resulted from this cause; and I suspect that the cases of unexpectedly violent effects in young children from a drop or two of laudanum, which we find related by writers, might, if carefully investigated, have been traced to this cause. Every practitioner should be aware of this fact, and guard against the use of laudanum rendered turbid by evaporation, especially when prescribing for the very young.

This tincture is very much used for obtaining the effects of opium, the properties of which it may be considered as fully representing. It has the advantage of operating more quickly than the opium in substance, and of facilitating the exhibition of the medicine in minute doses; but it is sometimes less acceptable to an irritated stomach, probably in consequence, in part, at least, of the alcohol it contains. The same cause renders it less suitable than the infusion of opium, or a solution of the extract, for application to tender surfaces, as to the conjunctiva, rectum, urethra, and even sometimes the skin, when highly irritated or inflamed.

The *dose* of laudanum equivalent to a grain of opium is thirteen minims, or about twenty-five drops. It should be remembered that a fluidrachm or teaspoonful contains on the average about 120 drops, and that one minim is about equal to two drops. The mistake has often been made of directing a teaspoonful of laudanum by enema, under the impression that it contained only 60 drops, or between twice and three times the amount of the ordinary dose by the mouth, whereas it is about quintuple that dose. Hence, profound narcotism has often been induced, when only gentle sleep was wanted. I have known of a fatal case of coma, occurring immediately after an enema of laudanum, and have not been without my suspicions that this was the cause of death. Not more than fifty or sixty drops should be given at first by injection. Tincture of opium is often used as a local anodyne; being employed as a lotion, or added to cataplasms, or in conjunction with other anodynes or with rubefacients in the form of a liniment. It may be added to the common soap liniment (*Linimentum Saponis*, U. S., Br.), in the proportion of one part by measure to three, according to the late London Pharmacopœia, or in equal measure according to the British; and this mixture is usually called the *Anodyne Liniment* (*Liniment of Opium*, LINIMENTUM OPII, *Br.*). Laudanum may be introduced into the external auditory meatus, or into the cavity of a carious tooth, upon a little raw cotton. From five to ten drops of it in a fluidounce of water may be inhaled in the form of spray, in irritative affections of the throat and lungs.

DEODORIZED TINCTURE OF OPIUM.—TINCTURA OPII DEODORATA. *U. S.*

This is a new preparation of opium, introduced into our Pharmacopœia at the late revision. It is made by macerating opium in water so as thoroughly to exhaust it of all matter soluble in that liquid; evaporating the infusion thus obtained to a certain measure, and agitating the residue thoroughly with ether; then pouring off the ether which separates on standing, and completely evaporating what remains of it; finally, adding first water, and subsequently, after filtration, half of its measure of alcohol. It will be seen that, in this process, all substances in opium soluble in alcohol and not in water, some of which are believed to be noxious, are got rid of; while, by washing with ether, the narcotina and the offensive odorous principle are separated, and alcohol is added at the end sufficient for its preservation. It is an excellent preparation, and, if properly made, may be relied on for whatever advantages may be possessed by certain empirical elixirs, which have acquired popularity through the want of an officinal preparation like this. It may be used for all the purposes for which laudanum is prescribed, and in the same dose; and may be preferred to it, whenever found not to agree with the patient, in consequence of constitutional peculiarities.

CAMPHORATED TINCTURE OF OPIUM.—TINCTURA OPII CAMPHORATA. *U. S.*—TINCTURA CAMPHORÆ CUM OPIO. *Br.*—*Paregoric Elixir.*—*Paregoric.*

This very useful and popular preparation is made by macerating powdered opium, camphor, benzoic acid, oil of anise, and honey, in diluted alcohol. Opium is the chief active ingredient, and camphor next in importance. The others may be considered merely as adjuvants, to improve the flavour, and render the tincture more acceptable to the stomach. Liquorice was formerly used in its preparation, and still is used by some apothecaries, though it has been omitted in the process of the Pharmacopœia, in consequence of the strong resemblance it occasions in the colour of the tincture to that of laudanum, and of the fatal errors that have originated in this cause. Certainly a little doubtful improvement in the taste should not be put into competition with life.

This tincture may be used when small doses of opium are indicated, and especially when its operation as a nervous stimulant is wanted. It is somewhat more stimulating than laudanum, and usually very acceptable to the stomach. It is much used in cough mixtures, but should not be given in the early stages of catarrhal affections, nor until expectoration shall have been established. It is better adapted to chronic catarrh, phthisis, asthmatic disease with copious expectoration, and pertussis at an advanced period, than to acute bronchial affections, except in their declining or suppurative stage. In slight diarrhœa, when the indication is simply to arrest the discharges, it is very useful; and it is an admirable remedy in the affection, as it occurs during the prevalence of epidemic cholera. It may also be usefully employed in slight gastric and intestinal pains or spasms, as an anodyne and carminative. To fulfil this indication it may often be used advantageously in infancy; but great care should be taken not to abuse it.

Containing only about one grain of opium in half a fluidounce, this tincture is not calculated to produce the full anodyne or soporific effects of that medicine. The dose of it, for the purposes for which it is usually employed, is a fluidrachm for an adult, and from three up to twenty drops for an infant, during the first and second year, being graduated to the age. It is rendered turbid by the addition of water, in consequence of the precipitation of the camphor.

Care must be taken not to confound this preparation with the *ammoniated tincture of opium*, which has been used in Scotland under the name of *paregoric*, though very different from the above. It is readily distinguished by its ammoniacal odour and taste, and is seldom if ever prepared in this country.

ACETATED TINCTURE OF OPIUM.—TINCTURA OPII ACETATA. *U. S.*

This is peculiar to the U. S. Pharmacopœia, having been introduced into it as a substitute for the *vinegar of opium* or *black drop*. It is made by macerating opium in a mixture of vinegar and alcohol. The only advantage that is claimed for it over laudanum is that it is somewhat weaker in alcohol, and that the active principles of the opium are modified by the acetic acid of the vinegar. The only known method in which such a modification could be produced, is that the acetic acid may take the place of the meconic acid, and form an acetate instead of meconate of morphia and the other alkaloids of opium. But, whatever may be the theory in the case, the preparation appears to agree with certain patients, who cannot take laudanum conveniently, in consequence of the headache, delirium, nausea, or other nervous disorder which it produces. It was a favourite with the late Dr. Joseph Hartshorne, of Philadelphia, who introduced it into notice, and whose large experience entitles his recommendation to great weight. The dose of it, equivalent to a grain of opium, is ten minims, or about twenty drops.

WINE OF OPIUM.—VINUM OPII. *U. S., Br.*—*Sydenham's Laudanum.*

This is a vinous tincture, made by macerating powdered opium, cinnamon, and cloves in sherry wine. After maceration with a portion of the wine employed, the U. S. Pharmacopœia completes the process by percolation with the remainder; thereby ensuring a more complete exhaustion of the powders than by maceration alone. The proportion of opium employed is such as to saturate the wine. The preparation differs from laudanum in having less alcoholic strength, and an addition of aromatic properties, which render it more agreeable to the smell and taste, and, in certain cases, more acceptable to the stomach. Some notice has been attracted to it as an application to the eye in ophthalmia, by the recommendation of Mr. Ware, who found it very useful. When dropped into the eye, it produces at first smarting pain, and a copious flow of tears; but these effects are soon followed by relief from the previous suffering, and considerable abatement of inflammation. The dose is about twenty drops.

VINEGAR OF OPIUM.—ACETUM OPII. *U. S.*—*Black Drop.*

The U. S. Pharmacopœia directs this preparation to be made by macerating opium, nutmeg, and saffron in diluted acetic acid, and afterwards subjecting the mixture to percolation with the same menstruum, taking care that the strength shall be uniform by adding sufficient diluted acetic acid to make a certain volume. Some sugar is added previously to the diluted acid. The vinegar of opium was introduced as a substitute for the *Lancaster* or *Quaker's black drop*, and is believed to be preferable to opium in substance or tincture, in certain cases in which the two latter forms disagree with the stomach or nervous system. This modification of effect may be owing to the absence of certain principles of opium soluble in alcohol, but not in water, or to the change of the natural meconate of morphia and of the other alkaloids into the acetate, or to both these causes. It is much stronger than laudanum, and may be given, for its full anodyne and soporific effects, in the dose of from seven to ten drops.

MORPHIA. *U. S.*

There are several methods of extracting morphia from opium. The U. S. officinal process consists essentially in macerating opium in water to exhaustion, adding alcohol to the infusion, precipitating the morphia by solution of ammonia, and purifying the precipitate by solution in boiling alcohol, and filtration while hot through animal charcoal. On cooling, the alcohol deposits the morphia in crystals. The object in adding alcohol to the infusion is that it may retain the colouring matter when the morphia is precipitated, which it does to a considerable degree. Thus procured, morphia contains a proportion of narcotina, from which, if deemed advisable, it may be separated by the agency of ether, which dissolves the narcotina, and leaves the morphia pure. For the preparation of the sulphate or muriate, however, this is not necessary; as the narcotina remains in the mother waters, upon the crystallization of these salts. As the acetate is usually prepared by evaporating its solution to dryness, the narcotina will contaminate it, unless previously separated from the morphia.

Properties. Morphia is in small, shining, colourless crystals, which are without smell, of a bitter taste, scarcely soluble in cold water, slightly so in boiling water, also slightly in cold alcohol, but freely in that liquid when hot, and almost insoluble in ether. Chloroform, the fixed and volatile oils, and aqueous solutions of potassa and soda dissolve it, and solution of ammonia has the same effect, but in much less degree. When heated in the open air, morphia burns, leaving a carbonaceous residue, which is wholly dissipated if placed on red-hot iron. Morphia affects test-paper like the alkalies, and forms soluble salts with most of the acids. When either the alkaloid, or one of its salts, is touched with strong nitric acid, it assumes a deep-red colour, which after a time changes to yellow. In the state of crystals, or in strong solution, both it and its salts are rendered blue by sesquichloride of iron. Ammonia, added to a mixture of solutions of chlorine, and of morphia or its salts, develops a dark-brown colour, which is removed by a further addition of chlorine. Precipitates are produced in solutions of the salts of morphia by the pure alkalies and their carbonates; but, when the alkali is added in great excess, the morphia is redissolved. Ammonia has the latter effect much less than potassa or soda. Astringent substances throw down from solutions of the salts of morphia a tannate of the alkaloid, which is soluble in acetic acid. Morphia consists of 1 equivalent of nitrogen, 35 of carbon, 20 of hydrogen, and 6 of oxygen, to which are added 2 equivalents of water in the crystalline state.

Medical Properties and Uses. Morphia is undoubtedly the main active principle of opium; but that it is not the only one is proved by the fact, that a certain quantity of opium produces a much greater effect than all the morphia which can be obtained from it, though it may be entirely exhausted. Thus, opium must be very good which will yield one part in ten of pure morphia. If the latter, therefore, were the only active principle of opium, one part of morphia should produce an equal effect with ten parts of opium; while, in reality, it is equivalent to no more than six parts. Which of the principles of opium it is that supplies this deficiency in the power of morphia has not been decisively ascertained. Nor are the effects of morphia precisely the same in character as those of opium. So far as I have been able to decide from observation and trial, I believe that morphia has precisely the same anodyne and soporific effects as opium, and closely resembles it in its stimulant influence on the brain. Like opium, also, it is apt to produce perspiration, though perhaps in a less degree; and is quite as much disposed to cause itching of the surface. But it is less stimulant to the circulation, less disposed to constipate, has less restraining effect on the secretions, and cannot be so well relied on for the suppression of morbid discharges. I am confident that it in general agrees better with the stomach, and is less apt to be followed by nausea, vomiting, and headache. It has appeared to me also to be less liable to provoke irregularities of mental action, and, with an equal excitant influence on the faculties and feelings, to derange them less frequently, and in a less degree.

Morphia itself is perhaps less certain in its effects than its salts; as, being insoluble or nearly so in water, it probably depends for its absorption, and consequent effects on the system, in some degree at least, upon the presence of acid in the stomach, and might operate more slowly, and feebly in the absence of acids. Hence it is that the salts are always employed, and morphia itself never. The salts most used are the sulphate, acetate, and muriate. So far as can be inferred from observation, there is positively no difference in the remedial effects of these salts upon the system; and one may be substituted for the other without disadvantage. All of them have one great advantage over opium, and those of its preparations the strength of which is determined by that of the opium, in their uniformity of dose. We know exactly how much of the narcotic principle we are giving when we prescribe a salt of morphia, while, in relation to opium, laudanum, etc., we are very far from this certainty, and may at one time give the medicine perhaps twice as strong as at another; for different parcels of opium, even bearing the same commercial name, not unfrequently have this diversity of strength.

The salts of morphia may be given in all cases in which the indication is to relieve pain, to procure sleep, or to quiet nervous irritation in any of its forms But they are less efficient as stimulants to the circulation in low forms of fever, and cannot be equally relied on for producing diaphoresis, for checking diarrhœa, or arresting profuse secretion or hemorrhage. They are preferable to opium in irritated states of the stomach, and in catarrhal affections, as they probably have less effect in producing dryness of the mouth and air-passages, and consequently in impeding expectoration. They often agree well with individuals on whom opium produces disagreeable effects. Thus, I have had under my care a female patient, whom a full dose of opium always kept awake during the whole night, but with whom the salts of morphia, in equivalent quantities, had their usual soporific effect. I believe, moreover, that there is less danger of giving them in over-doses. Though undoubtedly capable of fatal poisoning, they appear to be less so relatively than opium. A case was related to me by Dr. Charles Foulke, of New Hope, Pennsylvania, in which a woman took by mistake eleven grains of morphia, equivalent to about sixty-six grains of opium in anodyne effect, and yet recovered without having discharged any of the poison from her stomach. She became profoundly insensible, and during this state was delivered of a child, of the birth of which she was quite unconscious, and which survived. A case was recorded, some years ago, in one of the London journals, of which I made a note at the time, though I neglected to make the precise reference, in which a young man was believed to have taken somewhere between twenty and thirty grains of one of the salts of morphia, and yet escaped with life without evacuating measures, though the symptoms were very alarming.

Another advantage of the salts of morphia is the facility with which they can be applied endermically, and their great efficiency in this mode of application. They may be used in this way either for obtaining the general effects of opium, or to relieve some local affection, as neuralgic pain, and obstinate vomiting. Perhaps no remedy is more effectual, for the latter purpose, than one of the salts of morphia sprinkled upon a blistered surface in the epigastrium, denuded of the epidermis.

The salts of morphia are also specially fitted for the hypodermic method of administration; in other words, for injection into the subcutaneous areolar tissue, as recommended by Dr. Alexander Wood. In this method, they not only more rapidly and effectually relieve neuralgic pains in the neighbourhood of their application than by any other mode of using them, but also, according to Mr. Charles Hunter, of London, more quickly affect the system, and through this, even though applied at a distance from the seat of disease, remove the pain quite as effectually as if injected in its immediate vicinity. Sleep is induced by morphia thus used in a very short time, sometimes so soon as five minutes. In this mode of exhibition it is said to constipate less than when given by the mouth. Another advantage is that it can be administered, in some instances, where any other mode of exhibition is difficult or impossible. There are few affections in which opium is indicated, in which the salts of morphia have not been advantageously given in this way. Delirium tremens, violent adynamic delirium from whatever source, severe spasm of the diaphragm, stomach, and bowels, commencing tetanus, violent hysterical convulsions, and the eclampsia of puerperal women, are among the severer forms of disease in which it is said to have proved effectual. For the mode of using this and other medicines by hypodermic injection, the reader is referred to the general remarks on the subject, at *page* 78 of this volume. Unless under urgent circumstances, not more than about one-half of the dose should be given at first, which, under similar circumstances, would be required by the mouth for full effect; and it may afterwards be increased if found necessary. This caution has been rendered advisable by unexpectedly violent effects, which have sometimes originated from narcotic medicines administered hypodermically in ordinary doses. Any of the salts of morphia may be employed, and they should be given in solution; each dose being dissolved in from twenty minims to half a fluidrachm of water. Perhaps, on the whole, the acetate may be preferable, as least liable, when perfectly dissolved, to cause irritation.

The dose of either of the salts of morphia, equivalent in anodyne effect to a grain of opium, is, as near as I have been able to determine, one-sixth of a grain. One-eighth of a grain, I am quite sure, is less powerful than a grain of good opium; and one-fourth of a grain, I think, somewhat more so. Endermically, one-half of a grain may be used at first, and afterwards increased, if found necessary, to a grain or more. About one-third of a grain may be given, for a commencing dose, by enema, or as a suppository. Hypodermically, not more than a twelfth, or, at the outside, an eighth of a grain, should be administered as a beginning dose, under ordinary circumstances. As a liniment, morphia may be employed, dissolved in one of the fixed oils. The solution is most readily effected by first dissolving it in a little chloroform, and adding the solution to olive or almond oil.

SULPHATE OF MORPHIA.—*Morphiæ Sulphas.* U. S.—This salt is most used in the United States. It is prepared by mixing morphia with water, gradually dropping in diluted sulphuric acid till the powder is dissolved, and then evaporating and crystallizing. It is in beautifully white, minute, soft, feathery crystals, very bitter, readily soluble in water, and slightly so in alcohol. It is known to be a sulphate by yielding with chloride of barium a white precipitate insoluble in nitric acid. It may be given in pill or solution, in the dose of from one-eighth to one-quarter of a grain.

Solution of Sulphate of Morphia (LIQUOR MORPHIÆ SULPHATIS, *U. S.*) is directed by our officinal code to be prepared by dissolving eight grains of the sulphate in half a pint of distilled water. It of course contains one grain of the salt in each fluidounce. Though the solution becomes gradually coloured by time, I have found it perfectly efficient, upon trial, after having been kept a year or longer. It has the great advantage of easy divisibility, as regards the dose, to any desirable minuteness. For full anodyne and soporific effect, the dose is from one to two fluidrachms. From one-quarter to one-half the quantity may be inhaled in the form of spray, to relieve irritation of the air-passages. The solution is too feeble for subcutaneous exhibition; as from ten to twenty or at most thirty minims of the menstruum should contain the quantity of the salt to be injected.

It is to be regretted that this solution, as kept in the shops, is not always of the officinal strength. In some parts of the country, a solution containing 16 grains to the fluidounce has been habitually employed. This may readily lead to serious mistakes. The physician should always specially designate the stronger solution when he intends it; and the officinal solution should always be put up by the apothecary, when the simple officinal name is used.

ACETATE OF MORPHIA.—*Morphiæ Acetas.* U. S.—To prepare this salt, the U S. Pharmacopœia directs morphia, deprived of narcotina by means of ether, to be mixed with water, and acetic acid to be gradually dropped in till the morphia is dissolved. The solution is then evaporated, by means of a water-bath, to the consistence of syrup, dried by a gentle heat, and rubbed into powder. As thus obtained, it is amorphous, slightly coloured, and in general not wholly soluble in water. This is owing to the escape, during the drying, of a small portion of acetic acid, which leaves a corresponding portion of the morphia unsaturated, and of course, insoluble. All that is necessary to effect a perfect solution is to add a little distilled vinegar or diluted acetic acid. This salt is soluble in alcohol. It is known to be an acetate by giving forth an acetous odour on the addition of sulphuric acid. It may be given in pill or solution, and in the same dose as the sulphate. It is sometimes preferred for endermic and hypodermic application, under the impression that it is less irritant, and more readily absorbed.

MURIATE OF MORPHIA.—*Morphiæ Murias.* U. S.—*Morphiæ Hydrochloras.* Br.—*Hydrochlorate of Morphia.*—This is prepared, according to the U. S. Pharmacopœia, in the same manner as the sulphate. In Great Britain it is usually prepared directly from opium, and is probably more used than any other of the salts of morphia. It is in fine, white, feathery, acicular crystals, inodorous, bitter, and soluble in water and alcohol. It may be distinguished from the sulphate by affording, with nitrate of silver, a precipitate insoluble in nitric or muriatic acid, but soluble in an excess of ammonia. The dose and mode of administration are the same as those of the sulphate.

A *Solution of Hydrochlorate of Morphia* (*Liquor Morphiæ Hydrochloratis,* Br.) is directed in the British Pharmacopœia to be prepared by dissolving four grains of the salt in six fluidrachms of distilled water, to which eight minims of diluted muriatic acid and two fluidrachms of rectified spirit have been added. The use of the acid is to ensure the complete solution of the salt; that of the alcohol, to prevent spontaneous decomposition. It will be noticed that this solution is four times as strong as our officinal solution of the sulphate. Great care will be necessary to guard against the mistake of considering these two preparations, which have the same therapeutic properties and uses, as of the same strength. The full dose of the British solution is from thirty minims to a fluidrachm.

CODEIA.

This is the only other opiate alkaloid, the effects of which, until very recently, have been investigated. For the method of procuring it, the reader is referred to the Dispensatories. It is white, crystallizable in octohedra, much more soluble in water than the other alkaloids mentioned, soluble also in alcohol and ether, but insoluble in alkaline solutions. It is distinguished from morphia by the difference of its solubilities, and by not becoming blood-red with nitric acid, or blue with sesquichloride of iron. It is contained in small proportion in opium, constituting almost always less than 1 per cent. Various accounts of its effects on the system have been given, among the most reliable of which is that of Dr. Gregory, of Edinburgh. From three grains of it he obtained no obvious effect; but when the dose was augmented to five or six grains, he found it to increase the frequency of the pulse, to produce a feeling of warmth in the head and face, and itching in the skin, and to exhilarate the spirits. This condition, after lasting for several hours, was followed by unpleasant depression, with nausea and sometimes vomiting. This is so exactly the operation of morphia, in doses insufficient to produce sleep, as to suggest the inference that the codeia employed contained a small proportion of the stronger alkaloid; and, from the statement of Pereira, that all the specimens he had tried of codeia produced an orange-yellow colour with nitric acid (*Mat. Med.*, 3d ed., p. 2099), it is highly probable that this impurity is very commonly present. M. Barbier, of Amiens, found codeia, in the dose of a grain or two, to relieve painful affections of the viscera supplied with nervous influence from the sympathetic, while it produced no effect in pains of the back or extremities. Hence, he conceived it to act especially on the sympathetic system of nerves. It did not disturb the circulation or digestion, or produce constipation; and, when taken largely enough to cause sleep, occasioned no signs of cerebral congestion. Dr. Miranda, of Havana, found it decidedly beneficial in dyspepsia. It has not, however, been as yet proved to possess powers which are likely to render it a valuable article of the Materia Medica. Mauthner recommends it in the non-inflammatory spasms of the orbicular muscle of the eyelids occurring in infants. He applies a solution of one part in four of almond oil, by means of a hair pencil, three times daily to the lids. More recently, Professor Aran, of Paris, has made extensive use of codeia, and says of it that it possesses the most valuable properties of opium, is inferior to morphia in the relief of pain only because it requires to be given in larger doses, and is superior to it in these respects, that it does not cause heavy and agitated sleep, does not induce perspiration or cutaneous eruptions, nor trouble digestion, and finally, that it does not cause nausea, vomiting, or obstinate constipation. It is specially valuable in procuring calm, relieving obstinate cough, and suppressing the pains of rheumatism, gout, and cancerous affections. (*Am. Journ. of Med. Sci.*, Jan. 1863, p. 184.)

The French Codex prepares a *syrup of codeia* by dissolving twenty centigrammes of the powdered alkaloid in thirty-four grammes of distilled water, and adding sixty-six grammes of pure sugar. A tablespoonful of the syrup contains only four centigrammes, or somewhat more than half a grain of codeia.

In relation to the other peculiar principles of opium, *paramorphia* or *thebaina* was found by Magendie to produce tetanic spasms in the quantity of a grain, when thrown into the jugular vein of one of the lower animals, and thus to resemble strychnia and brucia in its action; *opiania*, according to Dr. Hinterberger, exercises powerful narcotic effects on the lower animals; and narcein or *narceia* has been thrown into the jugular vein of a dog, in the quantity of two grains, in several instances, without any observable effect. Not much is known of the operation of *meconin* or *meconic* acid; but they are supposed to have little effect.*

---

* Such was the extent of our knowledge on the subject of the active principles of opium, at the period of publication of the second edition of this work; and I have allowed the statements in the text to remain with little alteration, because, though most important investigations have been subsequently made, throwing much new light on the subject, yet the results have not assumed so definite a form, nor been so far confirmed by trial on the human subject, as to justify their admission among the established facts of our science. I have, therefore, deemed it best to introduce a notice of these researches in the form of a note, to await the result of future inquiry.

The author of the experiments referred to was M Cl. Bernard, of Paris. They were performed on several different species of the lower animals, and great care was taken to avoid sources of error; so that the conclusions may be received with great confidence; though it must be remembered that they cannot be relied on implicitly in relation to man. They relate to the relative powers of the several peculiar principles which have been extracted from opium; and these powers were tested by injecting solutions of the alkaloids into the subcutaneous areolar tissue: the effects upon the same animals being noted and compared, and the comparison afterwards extended to the different species, in all of which the results obtained were remarkably uniform.

M. Bernard tried six of these principles; *morphia*, *narceia* (narcein), *codeia*, *narcotina*, *papaverina*, and *thebaina* (thebain). Of these, the first three alone, namely, *morphia*, *narceia*, and *codeia*, were found to possess soporific properties; and these,

NARCOTINA.

For the mode of obtaining this substance from opium, the reader is referred to the U. S. Dispensatory. It exists uncombined in opium, which

---

while agreeing in this respect, were severally distinguished by peculiar properties of their own.

Morphia induced profound sleep, with sensibility blunted but not quite lost; as severe pinching caused obvious uneasiness, and sudden sounds occasioned movements of the animal, showing that they were heard. But there was a striking peculiarity in the mode of awaking. The animals exhibited an aspect as if startled or alarmed, and their hinder limbs were depressed as if partially paralyzed, so as to give to a dog the carriage of the hyena. The dog, too, under these circumstances, did not recognize his master, and sought to retire into some place where he could be hidden. Twelve hours elapsed before these effects had entirely disappeared.

Codeia, in whatever dose exhibited, produced a less profound sleep. The animal could be easily aroused, and sensibility was much less blunted. On awaking from the sleep produced by it, the animal exhibited less disorder of his faculties, and had none of the semi-paralyzed condition of the hinder limbs, mentioned as resulting from morphia.

Narceia caused a sleep differing from that of either of the other alkaloids, yet partaking of the nature of both. It was in the same dose more soporific than either; the sleep produced being more profound than that of codeia, without the leaden torpor caused by morphia; and the sensibility, though blunted, being much less so than by the latter alkaloid. The action of the narceia was characterized by calmness and want of excitability. The animal was not disturbed by any sudden noise, and on awaking, quickly returned to its normal state, with much less of the posterior weakness and mental confusion that marked the action of morphia. Narceia is peculiarly suited to the experimental physiologist; as the animal is perfectly passive under his hands, and makes no resistance even though in pain. The same effects produced by narceia on the lower animals were found by Drs. Debout and Béhier to be caused by it in man.

In reference to the *poisonous action* of the several principles; *morphia* is one of the least poisonous, *thebaina* the most so. Thus, a grain and a half of the muriate of thebaina, injected into the veins of a dog, killed the animal in five minutes; while thirty grains of the muriate of morphia, similarly exhibited, did not cause death. Next in poisoning power to thebaina was codeia. Much less of this then of morphia, injected into the veins, was required to cause death.

Another point of comparison between the alkaloids was in regard to their *convulsive effect*. While they poison, they also occasion convulsions of a tetanic character, sometimes violent. The only exception is *narceia*, which occasions no convulsions even in a fatal dose; the animal dying in a complete state of relaxation.

On the whole, then, the conclusions were that three of the alkaloids are *soporific;* namely, in the order of their power, 1. narceia, 2. morphia, and 3. codeia; the three others, not soporific, are convulsive, and all six in the order of their power in this respect are 1. thebaina, 2. papaverina, 3. narcotina, 4. codeia, 5. morphia, and 6. narceia. In their *tonic powers*, they have the following order; 1. thebaina, 2. codeia, 3. papaverina, 4. narceia, 5. morphia, and 6. narcotina. (*Archives Générales*, 6e sér., iv. 455.)

Therapeutic effects of the opiate alkaloids. This subject has been practically investigated by Dr. Ozanano, who has published the following results of his observations.

Pseudo-morphia and *meconin* are destitute of action.

still retains it in considerable quantities after maceration in water. The portion which water dissolves is probably taken up through the agency of the free acid of the opium. Narcotina is in white, silky, flexible, acicular crystals, without smell or taste, insoluble in cold water and alkaline solutions, very slightly soluble in boiling water, slightly so in cold and much more freely in hot alcohol, and readily soluble in ether and the diluted acids. The volatile and fixed oils also dissolve it. Though capable of uniting with the acids to form definite compounds, and with the muriatic and sulphuric acids to form crystallizable salts, it does not affect the colour of litmus, and must be considered as possessing but feeble alkaline powers. It is distinguished from morphia by its solubility in ether, by assuming a yellowish instead of red colour

---

Morphia acts on the whole nervous system, first on the brain, then on the spinal cord, and lastly on the ganglionic system, as evinced by the expansion of the capillaries.

Opiania is little known in regard to its effects, but is thought to be calmative and stupefactive like morphia.

Codeia is excitant, calmative, or stupefactive, according to the dose. Three or four grains stupefy like morphia, or prove anæsthetic like ether or chloroform. In very small doses, it calms, without exciting or but slightly. In moderate doses, it first excites and then calms. Its special influence appears to be exerted on the cerebellum and medulla oblongata. A disposition to retrogression in the movements has been observed during its action, and, after death from it, the parts mentioned are found engorged with blood. Hence its usefulness in coughs and gastralgic affections, acting through the pneumogastric nerve.

Narcotina is always excitant in its influence on a debilitated system, and, even in the dying state, it will for a time revivify the vital actions. The dose of it required for this effect is from five to ten centigrammes (about three-quarters of a grain to a grain and a half). It excites the pulse and increases the warmth of the body, without in the least stupefying.

Thebaina is more violent in its action than narcotic. In moderate doses, it agitates and even tetanizes, and occasions sleeplessness rather than the contrary. Its influence in producing tetanic spasm is exerted especially on the upper limbs, suggesting that it may perhaps prove useful in palsy of the parts. The author gave from three to six centigrammes (about half a grain to a grain) to a patient with paraplegia, but found the medicine to produce so much general uneasiness, and excitation, especially of the upper extremities, together with sleeplessness, that he was compelled to suspend it.

Narceia is a valuable calmative. In the dose of one or two grains, though it may not produce sleep, it gives the patient a feeling of calmness and perfect comfort; and produces these effects sometimes when morphia will not. It appears to exercise a special influence on the lumbar portion of the spinal cord. (*Ed. Med. Journ.*, Nov. 1864, p. 459; from *Revue de Thérap. Medico-chirurg.*, Oct. 15, 1864.)

Of the same alkaloid we are told that, of all the alkaloids of opium, it produces physiological sleep in the smallest dose. In a child, 10 years old, with phthisis, given in the quantity of about one-seventh of a grain through the day, it produced sleep and relieved the cough beyond all other means employed. (*Ibid.*, April, 1865, p. 947; from *Gaz. Méd. de Paris*, March 11, 1865.)—*Note to the third edition.*

with nitric acid, and by the want of the other properties before mentioned as characteristic of that alkaloid. If it be mixed with sulphuric acid, and then a piece of nitre be added, it becomes deep-red, while morphia, under similar circumstances, becomes brownish or olive-green. In this case, it is a mixture of the nitric and sulphuric acids that acts. Though tasteless, when pure, the compounds which it forms with the acids are very bitter.

Very different opinions have been advanced as to its effects on the system. While some have found it very powerful, and have ascribed to it noxious properties, others have taken or given it largely, without any observable effect, whether it was taken in the solid state or in solution. Twenty, thirty, and, as asserted by M. Bally, even sixty grains have been given with entire impunity. The probability, therefore, is that, when pure, it has little narcotic influence upon the system, and that the effects at first ascribed to it have resulted from the use of an impure preparation containing morphia, or some other active principle of opium. Dr. Roots, of England, was induced by the bitterness of its salts to employ it in intermittent fever; and Dr. O'Shaughnessy, of Calcutta, gave it with the happiest results in a great number of cases, considering it superior even to quinia in antiperiodic powers. He gave it in the dose of three grains three times a day, and never found it to produce narcotic effects, headache, nausea, or constipation, but to act powerfully as a diaphoretic. It is contained in opium in very varying proportions, from two to nine or ten per cent., and is generally most abundant when morphia is least so.

Denarcotized Opium.—Denarcotized Extract of Opium.—Denarcotized Laudanum. Under the impression that opium owed its unpleasant effects to narcotina, preparations were introduced into notice and extensive use, in which the medicine was deprived of this principle, retaining its other principles unchanged. Thus, opium or its extract was deprived of narcotina by ether, and a tincture was prepared from the denarcotized extract by treating it with diluted alcohol, so as to have about the strength of the ordinary tincture, and this has been called *denarcotized laudanum*. But, as before mentioned, it is extremely doubtful whether pure narcotina exercises any obvious influence on the system; and, if the preparations referred to have any advantage over the ordinary extract and tincture, the fact must be ascribed to some other modification of opium than the mere absence of this principle. The officinal *deodorized tincture of opium* (see *page* 757) renders unnecessary all other preparations in which the object is to get rid of narcotina.

European plant, probably owing simply to the difference of climate. The hemp of this country, if we are to judge from the odour it exhales when growing as a crop in the fields, and its viscidity to the touch, ought to be efficacious; and it would be an object worthy of attention to investigate this point experimentally.

In Hindostan the tops are cut after flowering, and when dried are tied together in bundles, two feet in length, each containing about twenty-four plants. These bundles are called *ganjah* or *gunjah* by the natives; and are essentially the same as the *hashish* of the Arabs. *Bang* is a name given to a mixture of the leaves and capsules, without the stem. The resinous exudation is collected in various methods from the growing plants in the flowering period, and formed into small masses which are called *churrus*. It is an alcoholic extract from the dried tops, or gunjah, that is recognized in the U. S. Pharmacopœia, under the name of *Extract of Hemp* or EXTRACTUM CANNABIS. In the British Pharmacopœia the preparation is recognized by the name of EXTRACTUM CANNABIS INDICÆ.

Properties. The tops of hemp, when fresh, have a characteristic odour, which, in the growing plant, is said sometimes to produce narcotic effects; and, in passing by fields of hemp, I have myself either felt, or imagined that I have felt, something of the kind. This odour is diminished in drying, and in the tops, as imported, is relatively very faint. Their taste is feeble and bitterish. The *churrus*, as described by Dr. Royle, is of a blackish-gray, blackish-green, or dirty olive colour, a fragrant and narcotic odour, and a slightly warm, bitter, and acrid taste. The *best extract*, as sold in our shops, is soft, of a blackish-green colour, a feeble narcotic odour, and a taste which is very slight at first, but becomes bitterish and herbaceous, and leaves a slight sense of acrimony for some time in the mouth.

Active Principles. So far as is known, the active principles of hemp are a *volatile oil* and a *peculiar resin* called *cannabin*. That the former has narcotic properties is to be inferred from the effects of the odour of the plant. The latter is a neuter substance, having a somewhat fragrant odour, especially when heated, and a warm, bitterish, subacrid, and balsamic taste. It is insoluble in water, but soluble in alcohol and ether, and from its alcoholic solution is precipitated white by water. M. Jacques Personne has made an experimental investigation into the chemical composition of hemp, from which it may be inferred that this narcotic owes its powers of affecting the system wholly to its volatile oil, and that the resin, when entirely freed from the oil, is inert. M. Personne found the oil to be complex, consisting of two carburetted hydrogens, one of which he proposes to name *cannabene*, the other *hydrate of cannabene*. (*Journ. de Pharm. et de Chim.*, 3e sér., xxxi. 50.)

Effects upon the System. The effects of hemp have a certain an-with those of opium, and, so far as regards the brain, with those of alcohol; showing that all three belong to the same class of agents. But there are also decided peculiarities in the operation of hemp, which distinguish it in a marked degree, from all other cerebral stimulants. It is feeble in its local influence, and but moderately stimulant to the circulation; producing a slight increase in the force of the pulse, with little or none in its frequency. Upon the brain, however, it acts with great energy. Like all stimulants to the cerebral centres, it first exalts, then deranges, and finally diminishes their functions. Hence, as a first effect, there is generally a remarkable exhilaration of the spirits, with a condition of mental reverie, in which a new state of existence seems to open, the most pleasing fancies present themselves, and the thoughts rush along in rapid succession, with little guidance or government from the will. In this state, there is often a disposition to laugh, sing, shout, or dance, or to do some other extravagant act; but, in other instances, the excitement betrays itself in a quarrelsome temper or deeds of violence; and in others, again, there is a quiet internal enjoyment which does not seek any outward expression. The sense of hearing is said, in some instances, to be greatly exalted. A not unfrequent peculiarity of this mental state is that objects seem further off than they really are, and sounds seem to come from a distance. The individual affected often speaks, after recovery, as having felt himself buoyed up, and rising above the surface of the earth. There is, too, a feeling of spiritual or intellectual exaltation, and of superiority to ordinary men. Sometimes there are impressions of duality, as if the patient were at the same time himself and another. Occasionally a species of intoxication is induced, with hallucinations or complete delirium. These effects come on within an hour or two, and are attended with a sense of giddiness, and, as writers generally assert, with aphrodisiac excitement. They gradually subside into a pleasing calm, a feeling of luxurious repose and indolence, during which the senses, particularly that of touch, become more or less obtuse, and general sensibility is so much impaired, that pinching, or other act ordinarily attended with pain is scarcely felt, and causes no uneasiness. Drowsiness soon follows, and, in three or four hours from the taking of the medicine, the person falls into a sleep or stupor, which continues about six or eight hours. During this condition, the pupils are generally dilated, and a state of the muscles is sometimes induced analogous to catalepsy, in which the limbs are perfectly flexible, and may be moved in every direction, but have a tendency to retain any position in which they may be placed. This latter affection, however, has not been noticed by those who have used the medicine in this country and Europe. Dr. O'Shaughnessy observed it in several instances among the Hindoos. Upon awaking, it is said that, instead of the nausea which is apt to follow the influence of opium, there is often a strong desire for food;

and the medicine is believed to have the property of exciting the appetite.

Though thus analogous in its course of action, and in many of its effects to opium, it yet differs from that narcotic remarkably, in one respect, in its operation on the brain. While opium elevates and for a time appears to invigorate the intellectual faculties, hemp, on the contrary, tends to confuse the mind, and induces a purposeless succession of ideas, which, though generally pleasing and even exciting, have no essential connection, and lead to no special result. It does not aid the student in acquiring or the writer or speaker in dispensing knowledge. It is the imagination and feelings which appear to be most highly stimulated, and altogether without the control of reason. The wildest vagaries, the most fantastic images, and the most gorgeous scenes, rapturous to every sense, and often voluptuous under the aphrodisiac influence of the drug, rush in throngs through the fancy, and seem to carry the soul along with them through long periods of passive, but diversified and thrilling adventure.

In its operation on the organic functions, also, hemp differs greatly from opium in several important points. Though, like it, sometimes diaphoretic, it is so in a much less degree; and has none of that tendency to produce constipation of the bowels and dryness of the mouth, or to check the mucous or biliary secretion which so often interferes with the beneficial influence of opium, and so much limits its use. It is, moreover, much less apt to induce nausea, and to leave headache or other disorder behind it.

From alcohol hemp differs in being much less excitant to the vascular system, less brutifying in its effects on the mind and temper, and indisposed to produce that thickness of speech, and staggering movement, so characteristic of the former stimulant.

There can be little doubt that, in over-doses, it is capable, like the other cerebral stimulants, of proving poisonous; but its effects in this respect have not been fully investigated. A case is reported by Prof. Schroff in which ten grains of an Indian preparation, after giving rise, in an exaggerated degree, to the characteristic effects of the medicine, produced an alarming prostration of the circulation; but the case ended in recovery. (*Dublin Quarterly Journ.*, xxvi. 231.) Alcohol is said to be the most efficient antagonist. (*Ann. de Thérap.*, 1865, p. 81.) Among those who use it habitually, it is said ultimately to impair the mental faculties. The remedies, both in its acute and chronic poisoning, would be the same as those required by opium.

Hemp probably operates, like opium and alcohol, through absorption. Drs. Ballard and Garrod, in their *Elements of Materia Medica*, state that it imparts an odour to the urine, like that produced by mixing the tincture with water, and somewhat resembling that of the Tonquin bean.

Therapeutic Application. Hemp was known to the ancient Greeks and Romans, who seem to have had some confused notion of its narcotic powers, though there is no reason to suppose that they ever employed it as a medicine. From time immemorial it has been used in India and Persia as a luxury, both internally and by smoking, in the same manner as opium. Its intoxicating and stupefying powers are spoken of by Linnæus, Murray in his *Apparatus Medicaminum*, and other early modern writers on Materia Medica; but it was not employed as a remedy, to any extent at least, in Europe or America, until introduced to the notice of the profession, not many years since, by Dr. O'Shaughnessy, of Calcutta, in the treatment of rheumatism, tetanus, cholera, etc.

The indications for the use of hemp, founded upon a knowledge of its physiological effects, are, 1. to allay pain, 2. to relieve spasm and various other nervous disorders, and 3. to promote sleep. In producing these effects, it probably operates in the same manner as opium; and it may be substituted for that medicine, for any of the purposes above mentioned, when opium has failed to act as desired, or is contraindicated by some idiosyncrasy of the patient, or when it is specially desirable to avoid its occasional nauseating influence on the stomach, its constipating effect on the bowels, and its tendency to restrain the secretions.

Another indication, derived from a supposed property of hemp not yet particularly noticed, is to produce uterine contraction. Attention, I believe, was first called to this property by Dr. Alexander Christison, of Edinburgh, who observed that, in several cases in which he had employed it during labor, it very much increased the intensity of the contractions.* The effect usually occurred, if at all, in two or three minutes after its administration, ceased after a few pains, and was not followed by any of the ordinary physiological results of its exhibition, as mental excitement, intoxication, or sleep; nor does the sense of pain appear to have been blunted. Indeed, the action took place much sooner than is required for its usual effects, and its powers seem to have been exhausted in the effort. Dr. Christison thinks the action of hemp more energetic, and perhaps more certain, than that of ergot. (See *Am. Journ. of Med. Sci.*, N. S., xxiii. 260.) Notwithstanding this supposed action of hemp, it has been found, in large doses, very promptly to suppress uterine pains in delivery. (*Ed. Med. Journ.*, ii. 667.)

With a view to the first indication, that, namely, of allaying pain, hemp has been used in different forms of *neuralgia*, in *acute* and *subacute rheumatism*, and in *gout;* and may be employed in these affections under the same circumstances as opium.

---

* Sir J. Y. Simpson informed me, when in Edinburgh, that the idea of using hemp of India for its effects in causing uterine contractions orginated with himself. (*Note to the third edition.*)

To relieve pain and relax spasm jointly, it has been considerably used in *tetanus*, and with variable results. Dr. O'Shaughnessy found it effectual on several occasions; a few successful cases have been reported by others; and, in some instances, where it has failed to cure, it has afforded relief. But the general result has not, I think, been favourable. As in the use of opium in this disease, it is necessary to increase the ordinary dose six or tenfold, or more, and to repeat the dose frequently. The medicine has been tried also in *hydrophobia*, but has proved quite powerless. In *epidemic cholera* it is said to have been found useful; but the property of checking alvine discharges, which renders opium so beneficial in that disease, is wanting in hemp, and it can act only by relieving pain and resolving spasm.

Hemp has also been used in various painless spasmodic affections, and nervous disorders, usually treated with the nervous stimulants and narcotics. In *convulsions* not connected with cerebral congestion, in *chorea*, *hysteria*, *languid or depressed spirits*, and *insanity*, it has been found more or less beneficial. For *allaying cough*, whether spasmodic, as in *pertussis* and *hysteria*, or dependent on *bronchial irritation*, as in different *pulmonary affections*, it may be resorted to as a substitute for opium, when this is contraindicated by its property of checking mucous secretion.

To *promote sleep*, it may be employed in any case of wakefulness, not associated with vascular irritation of the cerebral centres, and is said to have been used with special advantage in relieving the sleeplessness of drunkards.

In reference to its supposed property of promoting uterine contraction, it may be employed in *protracted cases of delivery*, in which it is preferable to ergot, if it be true, as may be inferred from the observations of Dr. Alexander Christison, that its operation is soon over, and not protracted like that of the medicine alluded to. It is thus free from the greatest objection to ergot, that, namely, of endangering the life of the fœtus by the steady and prolonged contraction of the uterus. The same property of hemp would render it useful in expelling the retained placenta, and in checking *uterine hemorrhage*, when sustained by a relaxed condition of the organ.

But, if preferable to opium under the circumstances above mentioned, in which that medicine, though indicated by certain symptoms, is contraindicated by others, hemp cannot be brought into competition with it in any of the cases to which they are both applicable. It is not only less efficient than opium, but is much more uncertain on account of the inequality of strength in the preparations used, and probably also in consequence of the inequality of its operation upon different individuals, even when it may be of the due strength

Dr. Fronmuller, who speaks of the practical use of hemp, with an authority based on the experience of a thousand cases, says that it produces sleep more like the natural than any other narcotic, causes considerable vascular excitement, does not disturb the secretory functions, and leaves behind no unpleasant sequelæ, and, finally, that it may be employed as a substitute for opium in all the phlegmasiæ, and all the typhous affections, without apprehension of evil result. It is, however, at the same time, less energetic and less certain than opium. (*Arch. Gén.*, 5e sér., xv. 745.)

Preparations. The forms in which hemp is ordinarily used in Europe and this country are the extract and tincture.

Extract of Hemp (EXTRACTUM CANNABIS), as recognized in the U. S. Pharmacopœia, is prepared by treating the dried tops with alcohol, and evaporating the tincture thus obtained. But it may also be procured by purifying the crude *churrus* of the Hindoos, by dissolving what is soluble of it in alcohol, allowing the undissolved impurities to subside, and then decanting and evaporating. In this way is prepared the *Purified Extract of Hemp* (EXTRACTUM CANNABIS PURIFICATUM) of the U. S. Pharmacopœia. A still purer form of it is prepared by a somewhat complicated process, for an account of which the Dispensatories may be consulted. One of the best tests of its strength, independently of actual trial, is its possession, in the highest degree, of the characteristic properties of smell and taste. Prof. Procter, who has specially investigated the subject, gives as its characteristic properties, its peculiar smell when slightly heated, its indifference to the alkalies, and its solubility in alcohol, ether, chloroform, benzole, and oil of turpentine; but the best test, he thinks, is nitric acid, which acts on it slowly when cold, but rapidly with heat, giving out red fumes, and converting the resin into an orange-red substance, which, when washed and dried, closely resembles gamboge in colour. (*U. S. Dispensatory*, 12th ed.)

The dose of the extract varies extremely, in consequence of the variable strength of the preparation. When of the best quality, half a grain of it will produce obvious effects, while ten or twelve grains are often required, and sometimes the drug is quite inert. It is best, as a general rule, to begin with one grain or less, which may be repeated every two, three, or four hours, until its effects are produced; and, if none can be obtained from this dose, gradually to increase it, until the amount is ascertained in which the parcel employed will act. In tetanus, ten grains may be given every half hour till it operates, and the quantity increased, if necessary. It may be administered in pill or emulsion. The latter is the preferable form, where speedy effect is required. It may be made by rubbing the extract up with a little olive oil, and then suspending it in water, or one of the aromatic waters, by means of gum arabic and sugar.

Tincture of Hemp (TINCTURA CANNABIS, *U. S.;* TINCTURA CANNA-

BIS INDICÆ, *Br.*) is made by dissolving six drachms of the extract in a pint of officinal alcohol (sp. gr. 0.835). The dose, equivalent to one grain of the extract, is about 20 minims or 40 drops. Dr. O'Shaughnessy gave 10 drops of the tincture every half hour in cholera, and a fluidrachm as often in tetanus, until the desired effects were produced, or the medicine showed decided signs of acting on the brain. This is among the substances which have been used in the form of spray, as made by the atomizer; from five to ten minims being mixed for the purpose with a fluidounce of water. It has been inhaled for the relief of nervous or spasmodic cough, and that attendant on phthisis. It has also been used hypodermically for the general effects of the medicine, in the dose of from ten to twenty drops.

VII. HENBANE.

HYOSCYAMUS. *Br.*

This is the *Hyoscyamus niger* of botanists, an annual or biennial herbaceous plant, indigenous in Europe, where it is also cultivated for medical use. It has been introduced into this country, and grows wild in some of our Northern States, especially in Michigan, where it abounds in the neighbourhood of Detroit. The whole plant is possessed of medicinal virtue. The U. S. Pharmacopœia recognizes the leaves and seeds.

HENBANE LEAF.—*Hyoscyami Folium.* U. S.—*Hyoscyamus.* Br.

The leaves of henbane, in their recent state, are somewhat hairy, viscid to the touch, of a sea-green colour, of a strong, disagreeable, narcotic odour when bruised, and of a mucilaginous, somewhat acrid taste. By drying they become nearly or quite inodorous and tasteless. They impart their virtues to alcohol and water. By destructive distillation, they yield a very poisonous empyreumatic oil.

HENBANE SEED.—*Hyoscyami Semen.* U. S.

The seeds are very small, roundish, compressed, of a grayish or yellowish-gray colour, in odour like that of the plant, and a bitter, oily taste. They are stronger than the leaves, but less used.

Active Principle. There is little or no doubt that the virtues of henbane reside in a peculiar alkaloid, denominated *hyosciamia*, which, however, though it has been isolated and accurately described, and its effects upon the system investigated, has scarcely been introduced into use as a medicine. It exists most largely in the seeds, but in small proportion even in these. Experiment has proved that both it and its salts are very poisonous. M. Gustave Lemattre, who has carefully investigated the physiological action of this and other alkaloids of the *solanaceæ*, with the view of determining their relations to one another, was unable to discover any appreciable difference, in this respect, between hyoscyamia and the two better known alkaloids, atropia and daturia. (*Archives Générales*, Août, 1865, p. 186.) Dr. A. B. Garrod, of London, has satisfactorily determined that the caustic alkalies, potassa and soda, entirely destroy the activity of hyoscyamia, and render hyoscyamus inert, in reference both to its local and general effects. It is not, however, injuriously affected by the carbonates of the same alkalies. (*Med. Times and Gaz.*, Dec. 1857, p. 589.)

Effects on the System. In doses scarcely sufficient to make themselves felt in health, hyoscyamus appears to act as a nervous stimulant in disease, calming restlessness, and other forms of slight nervous disorder, and, in cases of morbid wakefulness, producing sleep indirectly by removing the cause which prevents it. In full medicinal doses, it often produces, along with some increase in the frequency of pulse and general warmth, or with no observable effect of the kind, an agreeable and diffusive feeling of comfort, followed perhaps by slight vertigo, or other uneasy sensations in the head, and after a time by an easy natural sleep. Sometimes, however, it occasions headache, and, instead of sound sleep, gives rise to uneasy dreams, spectral illusions, or delirium. In not a few instances, nothing like sleep can be obtained from any ordinary dose; and, in such cases, some degree of sensorial or mental aberration is apt to occur, if the medicine is pushed. Dr. Pereira says that it is least apt to produce sleep in persons accustomed to the use of opium. A characteristic effect of it, as of other solanaceæ, especially belladonna and stramonium, when the system is fully under their influence, is dilatation of the pupil. Besides these effects, it often occasions heat or irritation in the fauces, sometimes increases the perspiration or urine, and, in rare instances, has caused a pustular eruption upon the surface. Instead of constipating like opium, it either produces no effect on the bowels, or acts as a laxative; the latter result being not uncommon. In some persons, or in certain states of the system, it occasions general febrile heat and irritation. After the subsidence of its full direct effects, a state of greater or less depression occurs, which, when the quantity taken has been very large, may amount even to prostration.

Hyoscyamus has not unfrequently been swallowed in poisonous quantities. This has happened most frequently with the root, which has been taken by mistake for that of some other plant, as parsnep or chiccory. The effects are usually giddiness, more or less stupor, extreme dilatation of the pupils, disordered vision, spectral illusions, diminution or loss of the power of speech, accelerated pulse, delirium, sometimes violent and maniacal, sometimes low and muttering, often attended with laughter, tonic spasms, convulsions, coma, paralysis, and at length great prostration, with small and irregular pulse, difficult breathing, and coldness of the extremities. From this extreme condition, however, reaction generally takes place, and comparatively few cases terminate fatally. Yet death has occurred in several recorded instances. Sometimes, with these narcotic effects, symptoms of severe gastro-intestinal irritation are exhibited, as nausea, vomiting, abdominal pains, and purging. The administration of the medicine by enema, and its external application over the abdomen, have been known to produce severe symptoms, though never, I believe, fatal.

The operation of the poison usually continues for about twelve hours before abating spontaneously. The remedies are the same as those for opium; full vomiting being the most important. From the experiments of Dr. Garrod, it appears that animal charcoal is an efficient antidote to hyoscyamia, completely destroying its powers, even in small quantities. This, therefore, should be used, along with the other means employed, in the treatment of its poisonous effects. Of course it can exert no influence on the poison after absorption. (*Med. Times and Gaz.*, Dec. 1857, p. 590.)

The lower animals are affected very differently by the herb. Some, as horses, cows, sheep, goats, and hogs, eat it with impunity; while birds and dogs are affected like man. It is not impossible that injury may have accrued, particularly to children, from the use of the milk of cows and goats which have been feeding on henbane.

The effects of hyoscyamia have been carefully investigated by Prof. Schroff, of Vienna. In a moderate dose it produced dryness of the mouth and throat, dilatation of the pupils, diminution followed by increased frequency of pulse, vertigo, hebetude of mind, general feelings of languor, and finally quiet sleep. By larger doses these effects were produced in a greater degree. The dryness of throat was very great, there was difficulty of deglutition, the sense of taste and smell were impaired, headache came on, and a deep and quiet sleep closed the series. A solution of it dropped into the eye caused a dilatation of the pupil more rapidly, intensely, and for a longer time than any other agent. Given to rabbits in poisonous doses it produced deep sleep, followed by death, without any convulsive movements, or apparent delirium. It appeared to occasion inflammation of the lungs. This result is somewhat singular; as the same animals can eat the herb freely with impunity. (*Wochenblatt der Gesellschaft der Aertze zu Wien*, June 16, 1855.)* Reisinger states that a single drop of an aqueous solution containing one part of it to ten of water, introduced into the eye caused dilatation of the pupil without irritation of the conjunctiva.

---

* A solution of this difficulty will be found under belladonna, the peculiar alkaloid of which so closely resembles hyoscyamia, as to have led to the supposition that the two might be identical. It appears that the reason why certain animals can feed with impunity on the leaves of the solanaceæ is that, in consequence of the mass of matter in their stomachs undergoing digestion, the proportion of the poisonous principle absorbed, within a given time, is insufficient to cause a poisoned state

Mode of Action. Though it would be difficult to prove that hyoscyamus operates upon the system through absorption, analogy leads almost necessarily to this conclusion. Its local action is that of a very moderate irritant, as shown by its occasional effects on the stomach, and its not unfrequent action upon the bowels. As a direct circulatory stimulant it is very feeble, being, in this respect, greatly inferior to opium; and, in many instances, the pulse is not affected, at least in frequency. The depression of the circulation which attends its full narcotic action is a secondary result, depending probably on the condition of the nervous centres. Its influence upon the cerebral centres is, I have no doubt, essentially stimulant; sleep resulting from a mild congestive action upon them, while, in a higher degree of the same operation, delirious excitement is produced, and, when the centres are quite overwhelmed, coma. The effect upon the pupil may be considered as a kind of sleep of the nervous centre, which causes contraction of the iris; or it may result from an excitant influence upon the sympathetic centres, producing a strong contraction of the dilating fibres.

Therapeutic Application. Henbane was known as a medicine to the ancients, but received little notice, until attention was attracted to it by Baron Störck, of Vienna, so famous for his experiments with this and other narcotics, and for the enthusiastic estimate he placed upon their therapeutic powers. Though this medicine has not realized all that was hoped from it, in consequence of his representations, it is, however, of no little value, and assuredly does not deserve the sentence of banishment from the Materia Medica pronounced upon it by M. Fouquier. (*Arch. Gén.*, i. 297 and 312.)

The indications which hyoscyamus is calculated to fulfil are to allay pain, produce sleep, relax spasm, and quiet nervous disturbance generally. These are, among others, the therapeutic effects of opium, which hyoscyamus probably as nearly resembles, in its soporific influence, as any other medicine. It is, however, in these respects, much inferior to opium, and incomparably less to be relied on; but there are certain circumstances under which, in consequence of its want of properties which sometimes interfere with the beneficial operation of that medicine, it may be used when opium cannot, and is admirably calculated to supply its place. *In the first place*, it is much less stimulant to the cir-

---

of the blood, which throws out the noxious matter before time has been allowed for it to accumulate so as to be destructive. But if one of the solanaceous alkaloids be injected into the veins, or even into the subcutaneous tissue, it acts on these animals poisonously, just as it acts on man. (*Note to the third edition.*)

culation than opium, and though, from this deficiency, it is of little use in supporting the system in certain conditions of debility where opium is highly valuable, it is more safely used in others, in which the anodyne and sopórific properties of opium are wanted, but its stimulant property contraindicates it. *Again*, it does not constipate like opium, but is rather laxative, and cannot, therefore, be substituted for it in diarrhœa; but there are frequent occasions in which this dissimilarity gives it great advantages. *Thirdly*, it has no such effect in restraining the secretion of mucus, bile, and urine as opium has; and may on this account be sometimes preferably employed, where it is desirable rather to promote than to impede those secretions, as sometimes in the early stages of inflammation of the bronchial tubes, liver, and kidneys. *Lastly*, from individual idiosyncrasy, or peculiarity in disease, opium not unfrequently occasions so much nausea, headache, delirium, or other disagreeable effect, that it cannot be given, however strongly called for as an anodyne or soporific. In such cases, hyoscyamus may sometimes be substituted with great advantage.

In *fevers*, hyoscyamus may often be usefully employed to quiet nervous disturbance and produce sleep, where the excitement may be too high for opium, or that medicine may be objectionable upon some one or more of the grounds just mentioned. This remark is especially applicable to the febrile affections of infants, in which a little hyoscyamus may often be advantageously conjoined with the refrigerant or laxative medicines, when there is considerable nervous disturbance, inquietude, and wakefulness; while opium might do more harm than good.

In the different *phlegmasiæ*, also, the medicine may be used to fulfil its proper indications, with no little benefit. This is particularly the case in *bronchial inflammation*, whether original, or connected with other diseases, as measles, pneumonia, etc., in the earlier stages, before secretion has taken place, and in any stage, whether acute or chronic, if the prominent indication is to promote secretion, and to allay cough. Opium might fulfil the latter indication at the expense of the former. Hyoscyamus, if it do not fulfil both, has certainly no effect in restraining the secretion. It should be combined with the expectorants employed. The same may be said of its use in *hepatitis, especially when the substance of the gland is affected.* In the peritoneal form of hepatitis, opium would be incomparably superior. In *nephritis*, when there is a great deficiency of secretion, hyoscyamus may sometimes be prefable; and for the same reason, applying, however, in this instance to the mucous and not the urinary secretion, there may be instances in which this narcotic would be more appropriate than opium in *inflammation of the bladder* and *urinary passages*.

To the relief of the more violent forms of *neuralgia*, or indeed *of excessive pain from any cause*, the anodyne powers of hyoscyamus are generally inadequate; though it may be tried in any case of the kind where opium cannot be given. There is, however, one condition of things in which it is peculiarly indicated; I refer to attacks of excessive *sensitiveness of the retina.* A case of this kind occurred to me, many years since, which will illustrate my meaning. A gentleman of highly nervous temperament, in the state of general depression following an acute disease, and after considerable depletion, was seized with an exquisite irritability and sensitiveness of the eye, which occasioned the most severe suffering. Light was torture to him; and it was necessary to close the outer shutters of the apartment, and to draw the curtains closely around his bed, so as to prevent the least particle from reaching him. Notwithstanding, however, this precaution, he complained of the intolerable brightness, the intense and insufferable glow, as of incandescent metal held immediately before his face, or of a concentration of the whole blazing light of the sun directed upon his vision; and language. in one who knew its resources well, and knew how to wield them powerfully under the impulse of a brilliant imagination, was exhausted to find expressions strong enough to convey an idea of his sufferings. Under the impression that he was affected with inflammation of the eye, he refused opiates altogether, though urged upon him. At last I prevailed on him to take a single grain of extract of hyoscyamus every hour. He had not taken more than three or four doses, when he experienced a sensible amelioration of his sufferings, along with the first narcotic impression of the medicine; and they continued to abate so long as the hyoscyamus was used. Convinced now of the nature of the affection, he consented to take an opiate enema, which immediately put an end to the symptoms. I have no doubt that a full dose of the hyoscyamus would have had the same effect. It is especially indicated in neuralgic affections of the eyeball, through its influence over the nervous centre of vision.

In *carcinomatous* and *other painful organic affections*, hyoscyamus may be alternated with opium, in the hope of protracting longer the period of susceptibility to the anodyne effect of the latter remedy.

Spasmodic and convulsive diseases, and other forms of nervous irritation, afford frequent occasion for the use of this narcotic. It can do little good in the more violent cases of painful spasm, such as spasm of the stomach, severe colic, the cramps of cholera, tetanus, etc.; yet in the milder conditions of the affection it may often be usefully combined with other medicines, as in *slight colicky pains* with cathartics, in the milder forms or stages of *colica pictonum* with alum, in similar conditions of the *biliary and urinary passages* with calomel in the former case, and bicarbonate of soda in the latter. In *asthmatic affections*, *pertussis*, and the *convulsive attacks of infants* dependent on teething or intestinal irritation, it may sometimes be advisable. Though inadequate to the cure of *epilepsy* or *chorea*, it may be usefully combined, in some instances, with the metallic tonics and nervous stimulants used in those complaints. In the multiplied nervous disorders of *hysteria*, hyoscyamus may now and then be had recourse to, with great benefit, for relieving distressing sensations, soothing inquietudes, and procuring sleep.

It is a favourite practice with many to *combine hyoscyamus with the more irritating purgatives*, under the impression that it tends to prevent their griping, without diminishing their purgative effects. For this purpose it is frequently used with the compound extract of colocynth, or with scammony, colocynth, and aloes severally.

Contraindications to the use of hyoscyamus are active congestion or inflammation of the brain, a very high degree of febrile or inflammatory excitement generally, and inflammation of the stomach or bowels.

Topical Use. Fresh henbane is sometimes used in the form of a cataplasm, or infused in hot water as a lotion or fomentation, to relieve pain and irritation, as in *hemorrhoidal* or *carcinomatous tumours, painful glandular swellings, gouty* or *rheumatic affections, scrofulous* and *cancerous ulcers, nervous headache*, etc. The extract is also employed for the same purposes. The remedy is sometimes used in the way of enema, to relieve *irritation of the rectum, bladder, urinary passages*, or *genital organs*. Oculists sometimes use it to *dilate the pupil* before the operation for cataract; a solution of the extract, or an infusion of the leaves being dropped into the eye, or the extract with lard, rubbed upon the lids and around them. The effect is usually produced within four hours, and continues twelve. The same application has been recommended after the operation for cataract, when there is danger of iritis, to prevent the pupil from closing. Used in this way, it does not affect the vision.

Administration. Neither generally nor locally should henbane be administered with one of the fixed caustic alkalies; and, when it is desirable to combine an alkaline action with that of the medicine, the carbonates should be used. The medicine may be given in substance, extract, or tincture. The dried leaves are so uncertain that they are very seldom used. The dose to begin with is from five to ten grains. The seeds should not be employed at first in more than half the smaller dose mentioned. The extract is much more frequently used.

Two *extracts* of henbane are directed by our national Pharmacopœia, one made by inspissating the expressed juice of the fresh leaves, the other by evaporating an alcoholic tincture of the dried leaves The former is called simply *Extract of Henbane* (EXTRACTUM HYOSCYAMI, *U. S.*), the latter *Alcoholic Extract of Henbane* (EXTRACTUM HYOSCYAMI ALCOHOLICUM, *U. S.*). As, in many parts of our country, the fresh leaves cannot be obtained, it is necessary either to use the imported extract, or to prepare the alcoholic. Unhappily, in either case, the preparation is of very uncertain strength, and often extremely feeble. The proper method of proceeding, in this uncertainty, is to give from one to three grains of the extract, and gradually increase the dose until it produces the desired effect, or at least evinces some narcotic power; and, having thus ascertained the strength of the parcel, to be guided afterwards accordingly. The dose will often be raised to ten grains before acting, sometimes even to twenty or thirty grains, or indeed much higher; for occasionally the extract is quite inert.

A *Fluid Extract* (EXTRACTUM HYOSCYAMI FLUIDUM, *U. S.*) was introduced into the U. S. Pharmacopœia at the late revision. It is a concentrated tincture, and may be given in the commencing dose of from five to ten minims.

The *Tincture of Henbane* (TINCTURA HYOSCYAMI, *U. S.*, *Br.*) is also officinal. It is prepared from the leaves by percolation with diluted alcohol, and is of such a strength that a fluidrachm represents rather less than eight grains. The same rule holds as to the commencing dose in this as in the extract; for the preparation is almost equally uncertain. From thirty minims to a fluidrachm and a half may be given at first.

Should *hyoscyamia* be used, not more than one-sixteenth of a grain should be given at once. As water dissolves it in small proportion, its aqueous solution may be used for dilating the pupil, being for that purpose dropped into the eye.

◆

VIII. BELLADONNA.

BELLADONNA LEAF.—BELLADONNÆ FOLIUM. *U. S.*—BELLADONNA. *Br.*

BELLADONNA ROOT.—BELLADONNÆ RADIX. *U. S.*, *Br.*

Origin. Under the name of Belladonna, the British Pharmacopœia recognizes the leaves of *Atropa Belladonna*, or *deadly nightshade*, which in our own are designated as Belladonnæ Folium; while in both, the root of the plant is officinal, with the title of Belladonnæ Radix. The plant is herbaceous, but perennial, indigenous in Europe, and cultivated in this country, but to no great extent, for medicinal purposes. Though all parts of the plant are active, the leaves only were officinally recognized until the recent revision of the Pharmacopœias, when the root, which is said to be much more active than the leaves, was adopted.* The fruit, though not specially used in medicine, merits a particular notice, as it is highly poisonous, and has frequently been eaten with fatal effect.

---

* Hirtz states that the roots are stronger than the leaves in the proportion of five to one. (*Ann. de Thérap.*, 1862, p. 22.)

Properties. The *root* is a foot or more in length, round, an inch or more in thickness, branched, grayish or brownish-white when fresh, becoming reddish-brown by drying, internally whitish and fleshy, of a faint peculiar odour, and sweetish, slightly bitter, mawkish taste. The *leaves*, which are often in unequal pairs, upon short footstalks, are from four to six inches long, ovate, pointed, entire upon their edges, of a deep-green colour above and paler below when fresh, of a dusky or brownish-green when dried, and, in the latter state, almost destitute of odour, and of a feeble subacrid taste. The *fruit* is a *berry*, at first green, then red, and, when ripe, of a fine glossy blackish-purple colour, about as large as a cherry, with a longitudinal furrow on each side, having the adhering calyx at the base, and containing numerous seeds in a juicy pulp. Its taste is sweetish, but mawkish, and not agreeable. All parts of the plant impart their medicinal properties to water and alcohol.

Active Principle. The ingredient to which belladonna chiefly if not exclusively owes its virtues is a peculiar alkaloid, denominated *atropia*, which will be specially treated of at the close of this article. Brandes obtained also a peculiar substance called *pseudotoxin*, and Lübekind supposed that he had detected another alkaloid which he named *belladonnin;* but little is known of their properties; and the ordinary existence of the latter may be looked on as doubtful. In relation to the incompatibility between atropia and caustic potassa and soda, even in very weak solution, the same remarks are applicable as were made upon hyoscyamia. (See *page* 777.)

1. *Effects on the System.*

Belladonna produces its characteristic effects upon the system, to whatever part it may be applied, whether to the stomach, the skin, the rectum, the cellular tissue, or the blood. When it is given in small doses, repeated two or three times daily, so as to bring the system gradually under its influence, the first effect usually noticed is a feeling of dryness and stricture in the fauces, soon followed, if the medicine be continued or increased, with slight uneasiness or pain in the forehead, vertiginous sensations, some dimness of vision, and occasionally dilatation of the pupil. The system may be kept long under its influence, with little other observable effect, by a careful management of the dose. In some very susceptible persons, however, the quantity usually given will act more powerfully; in one, producing blindness with large dilatation of the pupil; in another, decided pain in the head, flushed face, perhaps slight delirium, and an excited pulse.

From larger quantities, the effects are more quickly induced and more severe. A dose sufficient to bring the system at once decidedly under its influence, generally begins to show its effects in about half an hour. Dryness of the mouth and fauces, a feeling of stricture of the throat, difficult deglutition, thirst, dimness of vision sometimes amounting to blindness, dilated pupil, vertigo or headache, flushed face, suffused eyes, morbid sounds, irregular muscular contractions, and hallucination or delirium, sometimes followed by a disposition to sleep, sometimes attended throughout with wakefulness, are symptoms which most frequently appear, though not all generally in the same case, and which, having continued for twelve hours or more, gradually subside, without leaving any ill consequences behind. Along with more or less of the effects mentioned, there is generally some frequency of pulse and febrile excitement; but sometimes the circulation is at first little affected; and, when the cerebral phenomena are at their height, it is in a greater or less degree depressed. According to Lemattre, even when most excited, the pulse is diminished in tension or force. Not unfrequently there is an increase either of perspiration or urine, sometimes an eruption of scarlet rash on the surface, or irritation of the urinary passages. Occasionally, also, there is some nausea or griping pain with diarrhœa, intimating an irritating influence on the alimentary mucous membrane.

A curious fact in relation to the tolerance of belladonna by children has been made known by Dr. H. W. Fuller, of London. Having prescribed the extract in a case of chorea, and observing no effect to follow, he gradually increased the dose, and was surprised to find that very large quantities were borne without effect. He tried the medicine in other cases of chorea with the same result. In one girl of ten years, seventy grains were given daily with little effect. It was satisfactorily ascertained that the extract used was active; and, in one instance, atropia escaped copiously with the urine. He then tried the medicine in healthy children from five to twelve years old, and found the same tolerance evinced; and hence came to the conclusion that this singular phenomenon was ascribable to peculiarity in the systems of children. The quantity which was quite harmless in a child could not be borne by an adult. (*Med. Times and Gaz.*, July, 1859, p. 95.) Nevertheless, this experience of Dr. Fuller should not be hastily acted on; as peculiar unknown circumstances may possibly have influenced the result, and a similar tolerance might not be found in other instances.

Poisonous Effects. When poisonous quantities are taken, the effects described are experienced in a still greater degree. The circulation is accelerated and the heat of skin increased. The lips, tongue, and fauces are very dry, with a burning sensation in the throat and stomach, a sense of severe constriction of the throat, great difficulty of swallowing, and intense thirst. Not unfrequently there is nausea with ineffectual retchings; and sometimes strangury and bloody urine. The dimness of vision is extreme, and total blindness not uncommon, with the pupil greatly dilated, immovable and quite insensible to the brightest light. The hearing is also defective, and not unfrequently there is great difficulty of speaking, amounting sometimes to aphonia. General sensibility, which is at first somewhat exaggerated, after a time becomes blunted, and at last disappears. (*Lemattre.*) The face is red and swollen, and the eyes suffused with blood, sometimes as it were projecting, sometimes with a fixed meaningless stare, sometimes haggard, or wild and fierce. Vertigo soon comes on with visual deceptions, and the patient fancies that he sees objects in his vicinity which have no real existence, and makes motions accordingly. There are occasionally illusions of hearing, but they are much rarer than those of sight. In one case, complete somnambulism was observed; the patient imagining that he was a tailor, and for twenty-four hours making gestures as if working at his trade. The delirium is generally cheerful or gay; agreeable or ludicrous ideas present themselves; and the patient smiles or bursts out into laughter, or makes whimsical gesticulations. Sometimes, however, he is wild or even furious. The intoxication is not unlike that of alcohol. Stupor or coma at length supervenes, sometimes alternating or mingling with delirium, and even in sleep the dreams are occasionally ludicrous, producing bursts of laughter. Partial spasmodic contractions take place; the jaws being closed, the muscles of the face working, and those of the hands moving irregularly; but convulsions, though they sometimes occur, are very rare. On attempting to rise, the patient is unable to maintain the erect position, staggers, or moves with his body bent forward. Sometimes dysury has been noticed; but no increase of urine unless when the patient has indulged his great thirst. The pulse is now very feeble, the extremities cold, a disposition to syncope evinced; and, if the case is to terminate fatally, death is preceded by great prostration, subsultus tendinum, and profound coma. If, on the contrary, recovery takes place, which happens in the great majority of cases, even without medical interference, the symptoms gradually disappear, and, in two or three days, the patient is restored, usually remembering nothing of what had passed.*

The poisonous effects have been experienced from belladonna injected into the rectum, applied to blistered surfaces, and even employed in the form of a large cataplasm over the abdomen, with the cuticle unbroken.

---

* The symptoms above given, as characteristic of poisoning by belladonna, must not be considered as all occurring in every case, nor at the same time in the same case; but the affection of the pupil and of vision is probably uniform. Many of the symptoms have been drawn from an account, by M. Gautier de Claubry, of one hundred and fifty French soldiers, who, in one of the campaigns in Germany, ate the berries of the belladonna plant by mistake, and all suffered in greater or less degree. Many of them perished. (*Journ. Général de Méd.*, xlviii. 335.)

Its influence extends to the contents of the womb in pregnancy; and it is said that the aqueous humor, taken from the fœtus of one of the lower animals poisoned with it, will expand the pupils in another animal, if dropped into the eye.

The quantity necessary to destroy life varies so much, according to the constitution of the patient, and the strength of the preparation, that it is impossible to fix the poisonous dose, with an approach to precision Two grains of the extract have produced alarming symptoms; six grains administered by enema have had a similar effect; while it is asserted that a pound of the berries were eaten by a man on one occasion, who nevertheless recovered under treatment. (*Christison on Poisons.*)

Accurate accounts are wanted of the appearances left behind by the poisoning of belladonna. In general the stomach exhibits signs of some irritant action, and, in a case recorded by Gmelin, the vessels of the head were found engorged, and the blood was fluid. According to Lemattre, no lesions are found in the larynx or pharynx, or in the proper nervous tissues; and the only ascertained signs of disorder are offered in congestion. Hyperæmia of the pulmonary tissue is generally presented, but always in small foci, which sometimes unite, and are more frequent on the surface than in the depths of the lungs. There is also congestion of the meninges, especially at the base of the brain, and in the choroid plexus of the lateral ventricles. The pia mater is strongly congested; and the same is the case with the retina in chronic poisoning. The congestion, however, is not inflammatory, but rather hemorrhagic. No signs of exudation are discoverable. (*Arch. Gén.*, Août, 1865, p. 173.)

The *treatment* of this poisoning is exactly the same as that for opium, to which the reader is referred. As the insensibility of the stomach and bowels is often great, though not equal to that from opium, the same measures must be had recourse to, in order to favour the operation of emetics, including the loss of blood if the symptoms of cerebral congestion should be very prominent. The stomach-pump should never be trusted to, when the berries have been taken. In the state of coma, the electro-magnetic machine may be employed. In addition to the other measures, it may be advisable to use animal charcoal as an antidote, as in poisoning by hyoscyamus. (See *page* 779.)

Much has been said of an antagonistic relation between opium and belladonna, in their effects on the system, which is supposed to render them, to a certain extent, mutually antidotal in cases of poisoning from either; opium being considered as an antidote in poisoning by belladonna, and belladonna in poisoning by opium. The idea seems to have originated in the marked difference in their action on the pupil, which is dilated by belladonna, while it is often contracted by opium in large doses. It was supposed that there might be a similar opposition in other respects. Indeed, opium had been long previously employed, and advantageously, in the treatment of belladonna poisoning. But the application of belladonna to opium poisoning seems to have originated with Dr. Thomas Anderson, who, in a paper offered to the Physiological Society of Edinburgh, in 1854, gave the details of two successful cases in which he had used belladonna. Afterwards, Mr. Benjamin Bell, of Edinburgh, derived advantage, in a case of excessive action of atropia, from injecting a solution of morphia into the subcutaneous areolar tissue. (*Ed. Month. Journ.*, July, 1858, p. 6.) A few other cases of similar significance had been published in the journals of Europe and this country; but it was not till 1862, that the attention of the profession was generally aroused to the subject, by a paper of Dr. Wm. F. Norris, of Philadelphia, published in the *American Journal of the Medical Sciences* (Oct. 1862, p 395), describing two cases of opium poisoning, in which belladonna was employed with other measures, and giving a brief account of what was known on the subject up to the time at which he wrote. Since then, numerous cases have been published in which these medicines have been employed with apparent success as antidotes, the one of the poisonous effects of the other; and the general sentiment of the profession is probably favourably inclined to the idea of their mutual corrective powers. I have examined many of these reported cases, and have come to the conclusion, that we should not be justified, by anything which has yet been published, in relying practically upon the entire adequacy of either of these narcotics to the prevention of the poisonous effects of the other, and especially upon that of belladonna to obviate the danger from excessive doses of opium. *In the first place*, very many of the cases of poisoning from these narcotics, even from large quantities, end favourably, without any aid from the physician, sometimes in consequence of the spontaneous occurrence of vomiting, sometimes from a remarkable insusceptibility of the patient, but still more frequently from the dose taken having been sufficient to produce very alarming symptoms, and yet not large enough to destroy life; and it is very obvious, from a perusal of the published cases, that many of them belonged to this category. *Secondly*, in a large proportion of the cases recorded, measures had been successfully used for the evacuation of the poison, even at an early period; and this measure alone, if complete, is often sufficient to save life. *Thirdly*, in almost all instances, other remedies were employed in connection with belladonna, in opium poisoning, such as had often before proved efficient; so that it would be impossible to determine to which one, or to what combination of them, the favourable result was really ascribable. Besides, cases of failure have been recorded as well as successes;[*] and experiments have been performed, which, if confirmed, must, as appears to me, be decisive against the opinion of a mutual antidotal power. Dr. Bois has published, in the *Gazette des Hôpitaux*, an account of experiments, in which large doses of morphia and atropia were injected successively into animals, with consequences which induced him to conclude that, so far from neutralizing each other, they produced conjointly more powerful poisonous effects than could proceed from either acting separately. (*Arch. Gén.*, Août, 1865, p. 203.) Nor is this otherwise than might be reasonably expected *a priori*. Both poisons operate with a powerfully congestive influence on the brain; and both destroy life in the same way; that is, either by suspending respiration, or by the vast secondary prostration consequent on their primary excitant action. It is true that in some points they actually are antagonistic. Thus one contracts, the other expands the pupils; one agitates and greatly disturbs the cerebral functions, the other has a composing influence on these functions. This probably happens in consequence of a special direction of each poison to separate nervous centres; while, in regard to their fatal effects, they operate upon the same. Therefore, though belladonna may expand a pupil contracted by opium, and partially rouse a patient from the torpor produced by the latter; yet, in their fatal action on the respiratory centres, and in the secondary prostration, they coincide, and augment each other's effects; and at least in one of the fatal cases on record, it seems to me highly probable that death, which was caused by great debility, was really the result of the conjoint prostration from excessive doses of the two narcotics. To produce a decided impression in opium poisoning, large doses of belladonna are considered needful, and the quantity sometimes exhibited has been such as under other circumstances might endanger life. This fact has been advanced in support of the idea of antagonism; but the fact is that, when the nerve centres are under any powerful impression, much larger doses of one of the narcotics is required to produce a given effect than under ordinary circumstances. The enormous doses of opium tolerated and required in tetanus, delirium tremens, and some cases of neuralgia are familiar to every one. So, when the system is under a strong influence from opium, much more belladonna is required for the production of its own peculiar phenomena than in ordinary health. From all this it results, that it would be very hazardous to trust a case of poisoning from belladonna or opium exclusively to the supposed antidotal powers of either. Still, both of these narcotics may be advantageously used, with due attention to their special influences. Thus, the excessive agitation of belladonna poisoning, and the prostration of its advanced stage, may be relieved by the composing and stimulant influence of opium; while the stupor and depression which mark the later stage of the effects of opium, may be counteracted by the agitating and supporting action of belladonna; but care should be taken that the two should not coincide in their poisonous effects; that is, that neither the early nor the advanced stages of their action should come together. As has been before mentioned, one of the great dangers of opium poisoning is the secondary prostration. Here belladonna may be used as a stimulant, in like manner as brandy, carbonate of ammonia, etc. In the similar stage of belladonna, when the great danger is debility, opium may sometimes perhaps save life by its stimulant action, in the same manner as the alcoholic stimulants.

---

[*] A case is recorded in the *Bost. Med. and Surg. Journ.* (lx. 468). in which overdoses of sulphate of morphia and extract of belladonna were by accident taken simultaneously, and in which, instead of any material counteraction, there was an exaggeration of effect, which could scarcely have arisen from any other cause than the conjoint influence of both. In the *Med. Times and Gaz.* (Nov. 1866, p. 473), there is an account of a case in which the two poisons were taken in connection; a liniment intended for external use, containing extract of belladonna and laudanum, having been swallowed by mistake. The symptoms of the two narcotics were jointly produced; and, though there was scarcely enough of either or both together to cause death, yet the symptoms were alarming. (*Note to the third edition.*)

On the *lower animals* the effects of belladonna vary greatly. The herbivorous eat the plant with apparent impunity, while the carnivorous are affected like man. Instances are mentioned in which the horse, the ass, and rabbits have eaten of it freely, with no observable symptoms, while dogs are poisoned. A rabbit was fed on it for eight days, and was not observed to suffer. (*Journ. de Pharm.*, x. 85.)*

2. *Mode of Operation.*

Belladonna is a feeble local irritant, has upon the circulation either a moderately excitant effect, or no direct effect whatever, and powerfully stimulates the brain. It undoubtedly operates on the system through absorption. The proofs of this fact are that it produces the same effect to whatever surface it may be applied, even when introduced into the blood, and that its active principle has been detected in the urine. It is asserted that the urine of a rabbit which had been fed upon it, caused dilatation in the pupil of a cat to which it was applied. According to M. Runge, of Berlin, belladonna, stramonium, and henbane, are the only substances which have this effect on cats. (Orfila, *Toxicologie.*) The circumstance that this plant, as well as others of the same natural family of Solanaceæ, is eaten by some animals with impunity, while it kills others, proves that the medicine acts on the susceptibility of the tissues, and not by a chemical reagency upon their organization. From the succession of phenomena produced, it may be inferred that belladonna acts with a powerful irritant influence, primarily on the centres of conscious perception in the brain and annular protuberance, and subsequently on the spinal marrow; as sensibility to pain is lost, while yet reflex action continues, showing a persistent sensitiveness of the gray matter of the cord. The congestion of the cerebral membranes and those of the upper part of the spinal cord, observed after death, confirms this view of the operation of the poison. (*Lemattre.*)

---

* The generally admitted fact, that plants poisonous to man are taken with impunity by certain of the lower animals, does not, according to M. Lemattre, imply that the active principles are not poisonous to these animals, if absorbed into the circulation. M. Lemattre found that all animals, upon which the trial was made, were susceptible of the poisonous action of atropia, and the other solanaceous alkaloids. The impunity, therefore, with which rabbits, goats, etc., may eat the leaves of the belladonna and stramonium plants must be attributed to the non-absorption of the alkaloids from the stomach, or so slow an absorption that sufficient does not enter the circulation at one time to produce deleterious effects. This may be explained in part by the fulness of the stomach with various fresh vegetable matters, which interfere with the rapid digestion of the poison. (*Archives Gén.*, Juillet, 1865, p. 89; also *Lancet*, Sept. 2, 1865, p. 269.)—*Note to the third edition.*

One of the most curious effects of this medicine, and of other Solanaceæ, is that which they exert on vision and the pupil. The dilatation of the pupil is probably owing to an irritant influence upon the centres of the sympathetic nerve, a branch from which governs the action of the dilating fibres of the iris. Its influence on vision may be ascribed, when complete amaurosis exists, to a constriction of the blood-vessels of the retina, depriving it for a time of blood, and, of course, of sensibility; but a less degree of visual disturbance, such as presbyopia, or an inability to see near objects, while the distant are visible, is probably referable to the action of the sympathetic on the ciliary muscles, thereby disturbing the accommodating powers of the eye. When belladonna is locally applied to the eye, the effect is much more prompt than from its internal use, and quite as great if not more so. But, under these circumstances, the vision is not affected, and the nervous centres of the retina, therefore, not acted on. Generally only the eye to which the application is made is affected; but it is asserted that the other eye sometimes participates; in which case it is possible that the medicine may have been absorbed, and reached the cerebral centres. The dilatation of the pupil and dimness of vision appear to be direct, without any preceding excitation of the organ.

3. *Therapeutic Application.*

It is uncertain whether belladonna was used by the ancients as a medicine. The earliest account we have of its employment in modern times was about the close of the seventeenth century, when it appears to have passed from empirical use into the hands of the regular profession. At first it was chiefly valued as a remedy in cancerous tumours and ulcers, of which it was supposed sometimes to effect cures; and cases were recorded which would go far to confirm this opinion of its powers, did we not know how frequently erroneous diagnosis has led to false estimates of the efficacy of medicines in these affections. At present there are very few who would maintain that belladonna could do more than palliate in true cancer. But, though now little employed in those complaints for the cure of which it was first brought into notice, it has been found, by abundant experience, to possess powers which render it highly useful for various other purposes.

Indications. The chief indications which belladonna is calculated to fulfil are, 1. to *subdue pain*, 2. to *relax muscular spasm and rigidity*, 3. to *stimulate the nervous centres*, and 4. in reference specially to the eye, to *lessen the sensibility of the retina*, and *dilate the pupil*. As a soporific, it cannot be relied on, and is, I believe, never employed.

One mode in which it operates, in answering these purposes, is by rendering the nervous centres insusceptible of irritative impressions, and incapable of transmitting irritative action; but there can be no doubt that it is capable also of operating directly on the peripheral sensibility of the nerves, and of producing the same insusceptibility at their extremities as at their centres. Whether it acts in this way by an immediate or by an indirect sedative agency it would not be easy to determine; but, as the evidence is irresistible that it occasionally does stimulate the nervous centres, it is safest to admit that in this respect its action is uniform, and that the depression evinced is an indirect result of an active congestion in all instances. What tends to confirm this view is, that the medicine has not been found applicable to cases, in which the nervous centres were already in a state of active congestion or inflammation; the very condition in which it would seem to be specially indicated, were it directly sedative.

In the relief of painful and spasmodic affections, belladonna seems to be capable of something more than a mere temporary influence. Not only does it give ease; but, by a perseverance in its use, we not unfrequently obtain positive cures from it, which opium itself, though more powerful as a mere anodyne, is unable to effect. It would appear, therefore, to produce some permanent modification in the nervous tissue, incompatible with that which existed in its morbid condition, in other words, to act as an alterative as well as an anodyne. Another advantage which it possesses over opium, in the treatment of chronic or frequently repeated painful affections, is its entire exemption from the liability of abuse as an exhilarating agent, which constitutes one of the greatest objections to the use of that most fascinating drug.

Contraindications. The contraindications to the use of belladonna are, as in this class of medicines generally, active congestion or inflammation of the brain, inflammation of the stomach, high inflammatory or febrile excitement, and a plethoric state of system; in all which conditions, should any special symptom call for this remedy, its use should be preceded by depleting measures.

I shall treat of the special complaints in which belladonna is used, under the several indications above mentioned.

1. *For the Relief of Pain.*

a *Neuralgic Affections.* In these belladonna displays its most useful powers; and I know few remedies more effectual in their cure. No matter where the pain is seated, provided it be purely functional, that is, connected with no inflammatory or other organic disease affecting the nerve or its centre, the medicine may be employed. It may be used both internally and locally; and, when the pain is near the surface, or in any position to which near access can be obtained, it is generally advisable either to depend on the topical use of the remedy, or to employ it in the two methods jointly. The general rule is to administer it in quantities sufficient to produce obvious effects, without going so far as to cause delirium, stupor, or dimness of vision approaching blindness. Though these latter phenomena have seldom if ever proved really dangerous, when proceeding from medicinal doses, yet they are not necessary to the anodyne effect, and are, therefore, better avoided. I am in the habit, in neuralgic cases, of giving half a grain of the extract three times a day, and, if no effect is experienced from this dose, of gradually increasing it, until dryness of the throat, dimness of vision, dilatation of the pupil, slight frontal uneasiness, or feelings of fulness or giddiness in the head are produced; and of afterwards so managing the dose that these effects should not be exceeded. Sometimes the first dose will act with unexpected energy; in which case it should be reduced to one-third or one-quarter of a grain, and afterwards increased again if necessary. More frequent repetition than three times a day is unnecessary to maintain a continued operation of the medicine, and might lead to cumulative effects.

Both in the *neuralgic and spasmodic diseases* belladonna may often be very advantageously associated with those tonics which have the effect of strengthening the nervous centres, as quinia, the chalybeates, and the preparations of silver, copper, and zinc; the narcotic and tonic being administered conjointly in the same pill, or separately, as may be most convenient.

Modes of Application in Neuralgia. Some remarks in relation to the method of using the remedy locally in these cases may be advisable here. A decoction of the leaves may be employed, or the extract; and one or the other of these may be used in the form of lotion, cataplasm, liniment, ointment, or plaster. Of the use of *atropia* I shall treat under a separate head. The extract may be brought into the state of liniment by simply rubbing it with a little water; and of an ointment by incorporating it with lard. The plaster is officinal. Usually it will be sufficient to make the application upon the unbroken skin; but the effect is more speedy and much more powerful when the remedy is used endermically, the cuticle having been removed by a blister. In this case, the extract should be used mixed with water or lard, and never at first in quantities exceeding two or three grains, which may be increased if necessary. As it occasions some pain if brought into direct contact with the denuded surface, it may be applied, as recommended by MM. Trousseau and Pidoux, spread on a piece of linen with the uncovered surface next the skin, and protected by means of adhesive plaster. The effect is thus gradually produced, and without pain. To the writers just named I am also indebted for some of the following observations in relation to the local use of the medicine in special cases.

In *neuralgia of the scalp*, a decoction of the leaves made in the proportion of half an ounce to the pint of water may be used locally. With this the hair may be saturated; and a thick linen compress thoroughly moistened with it, having been applied over the head, the whole should be covered with a cap of oiled or waxed linen, or silk. A solution of the extract in the proportion of a drachm to the pint, or the officinal tincture diluted with four parts of water, may be similarly employed.

In *supra-orbital neuralgia*, or that of the *eyeball*, from five to ten grains of the extract, mixed with a little water, may be rubbed upon the lids and around the eye, with gentle friction, for ten or fifteen minutes; and the process may be repeated every two or three hours, the part being in the mean time covered with a light compress, until the pain is relieved. Or a cataplasm made with a solution of the extract and flaxseed meal may be applied over the whole eye. The same method may be employed in other forms of *facial neuralgia;* but in the *infra-orbital* and *submaxillary forms*, the authors above mentioned prefer the friction to be made upon the gums or inside of the cheeks. Of course, care must be taken that the patient do not swallow the medicine. In painful affections of the *ear*, a solution of the extract may be injected into the meatus, and cotton afterwards introduced impregnated with the same. In *toothache*, the extract itself may be introduced into the carious cavity.

In *neuralgia of the limbs or trunk*, the application should be made as near to the seat of pain as possible; and in these, the endermic method will often be advisable. In *sciatica*, which is one of the most obstinate forms of the affection, the blistered surface should be made in the course of the nerve as it passes out of the pelvis. MM. Trousseau and Pidoux have met with great success, in very obstinate cases of this affection, by making an incision through the skin, between the great trochanter and ischium, and inserting a ball in the form of a pea, containing from one to five grains of the extract with a little opium; thus gaining the effects of an issue with those of the narcotic.

In *angina pectoris* the medicine has been used locally with advantage. Dr. Davies relates a case in which a plaster of belladonna was applied to the chest after tartar emetic, and before the ulcers from this had healed. Alarming symptoms were induced; but, on their subsidence, it was found that the angina had ceased. (*Lect. on Dis. of Lungs and Heart*, p. 496.)

In the internal neuralgic affections of the abdomen, as *gastralgia, enteralgia, nephralgia*, etc., the external use of the medicine should be resorted to when the complaint is complicated with vomiting or purging, while opium is used internally. But, in the contrary condition of constipation, it would be better to try the effects of extract of belladonna internally.

Lead colic and *nervous colic*, which are really forms of intestinal neuralgia, may be advantageously treated in their milder and more chronic conditions, with belladonna combined with alum or iodide of potassium internally, and frictions with an ointment of the extract externally over the surface of the abdomen.

b. *Rheumatic and Gouty Disease.* Among the painful affections which, in like manner with neuralgia, may be treated with the internal and external use of belladonna, are *rheumatism* and *gout*. The medicine has been employed even in *acute rheumatism*, and is asserted to have proved very successful. After a proper use of the lancet, and in connection with purgatives and arterial sedatives, I have no doubt that it would prove serviceable, given so as to maintain a constant and decided impression; and, in cases where some idiosyncrasy may forbid the use of opium, might be had recourse to with great propriety. But it is in the *nervous or neuralgic forms* of these diseases that belladonna is especially indicated; and here it is among the most efficacious remedies. It is also frequently serviceable in the *shifting forms of subacute rheumatism* without fever; and, in the *chronic forms of the same disease*, is a standard remedy, given in connection with one or more of the various alteratives used. In this form of the disease it may also be advantageously employed locally, in the shape of poultice or plaster; the former being most conveniently applied to the joints, the latter over muscular parts, as to the small of the back in *lumbago*, and to the side in *pleurodynia*.

c. *Other Painful Affections.* There is a number of painful affections, local in their character, in which the topical use of belladonna has been resorted to with more or less benefit. In *dysmenorrhœa* it has been introduced into the vagina, either by injecting a decoction of the leaves or solution of the extract, or in the form of a pill containing half a grain or a grain of the latter preparation. *Fissures of the anus, painful piles,* and *excessive sensitiveness of the rectum,* may often be usefully treated with an ointment made by mixing the extract with lard; not more than from half a grain to a grain and a half of the former being used at the first application, especially if introduced within the sphincter. *Phymosis* and *paraphymosis, swelled testicle, inflamed urethra,* and *various painful tumours* and *ulcers, cancerous, scrofulous,* or simply *phlegmonous,* are additional affections in which the extract has been recommended, in the shape of cataplasm or ointment, with the view of relieving pain.

2. *For the Relief of Spasm or Muscular Rigidity.*

Singular as it may seem, the painful spasmodic affections are less benefited in general by belladonna than either pure neuralgic pain, or spasmodic affections without pain. Thus, spasms of the stomach, bowels, ureters, hepatic ducts, etc., and those of tetanus, do not yield readily to belladonna, perhaps because the centres of irritation in these cases are in the spinal marrow, upon which that narcotic may exercise less power than on the cerebral centres. Still, the medicine has been used in *tetanus,* and in certain *colicky affections,* and not without favourable results. Cases are on record of its successful employment in *spasmodic constriction of the bowels, with obstinate constipation,* and even in *ileus.* As a remedy in colica pictonum, it has already been spoken of; but this is rather a neuralgic affection of the bowels, than simply spasmodic, and, moreover, probably depends more on the local influence of the lead upon the nervous tissue of the bowel itself, than upon the nervous centres. In cholera it is said to have been advantageously employed in large doses; and, independently of its use in relieving the spasms of that disease, it may possibly act favourably, by its stimulant influence over the sympathetic centres, causing a contraction everywhere of the relaxed capillaries, and thus restraining the excessive discharges.

In painless spasms, the medicine is often highly beneficial. In these affections, it not only yields relief, but serves, as in neuralgia, to make a permanent impression on the nervous centres, which sometimes proves curative; and, in like manner, may be usefully combined with the antispasmodic tonics, as quinia and various metallic salts. It will very seldom cure *epilesy;* but, in some purely functional cases, it is said to have had this effect, and it will often ameliorate the symptoms. The patient should be kept under its very moderate influence for a long time, with occasional intermissions; and, about the period of the expected paroxysms, it should be given more freely.

In the *non-epileptic convulsions of puerperal women and children* it has been highly recommended; but should not be given when in these cases there is active cerebral congestion, or any suspicion of inflammation. In infantile cases, it should be confined to the convulsions which depend on some extra-cranial irritation, such as teething or spasm of the bowels. In both instances, it is best adapted to those attacks in which there is a frequent recurrence of the paroxysms, and should be given in the interval, in order to prevent the convulsions, and not during their continuance.

On the continent of Europe, belladonna was long since used in *hooping-cough*, but was neglected until the practice was at a recent period revived by Bretonneau. In this country, it has been employed and highly recommended by Dr. Samuel Jackson, late of Northumberland, who gave to children two years old from the twelfth to the sixth of a grain of the extract, twice or three times a day, increasing the dose until the pupil became dilated. Dr. Hiram Corson, of Montgomery County, Pennsylvania, also used it with great success. My own experience with it is confined to a single case. This occurred in an infant, to the chest of which I applied a belladonna plaster. The child was soon afterwards attacked with convulsions, which were frequently repeated, and very alarming. It recovered, however; and the hooping-cough ceased with the convulsions. It is possible that the medicine may have cured the disease, and may not have caused the convulsions, which are not uncommon in hooping-cough; and I am disposed to think that this was really the case; for belladonna very rarely produces this effect, even in poisonous doses. The occurrence, however, deterred me from afterwards having recourse to the remedy in that disease. It is thought by some to be more efficacious in hooping-cough, when associated with sulphate of zinc.

In *asthma* it has been strongly commended. It has been used internally in this complaint, being given during the intervals of the paroxysms, so as to sustain a steady impression; but the most efficient method of employing it is by the inhalation of its fumes. For this purpose, the dried leaves may be smoked in a pipe, or in the form of cigars, made like those of tobacco. Great care, however, must be taken that too great a narcotic effect is not produced. This use of the remedy no doubt originated in a similar employment of stramonium, which very closely resembles belladonna in its medical properties. Another mode of using the remedy, in the same complaint, is by inhaling the vapour from a decoction either of the leaves or extract; two drachms of the former, or fifteen grains of the latter, being boiled with a pint of water. The smoking of the leaves, steeped when fresh in a strong infusion of opium and then dried, is said to have afforded relief in phthisis. As the breathing of the fumes arising from the combustion of paper, impregnated with nitre, often affords great relief in the asthmatic paroxysm, the idea occurred to M. Dauncey, an apothecary of Bordeaux, that advantage might accrue from a similar impregnation of the leaves of belladonna before being smoked. Accordingly he prepared cigars from leaves thus treated, and found them to answer the purpose intended. A solution of nitre containing three ounces is sprinkled on three avoirdupois pounds of the leaves, spread out after drying. The nitre thus penetrates the tissues of the leaves, and is left after the dissipation of the moisture. Another advantage of the preparation is that the carbonaceous matter of the smoke is consumed in the combustion. (*Am. Journ. of Pharm.*, xxx. 404.)

In *muscular rigidity*, the local application of belladonna has been found very useful in a number of different affections. In *constriction of the sphincters of the anus* and *neck of the bladder*, and in *spasm of the urethra*, it has been employed in poultice, or in the way of friction to the perineum, with the extract mixed with lard; and, in the urethral affection, it has been introduced into the passage by means of a bougie smeared with the ointment. *Rigidity of the os uteri in delivery* is said sometimes to yield to the local application of the extract. It has been employed externally in strangulated hernia, to produce relaxation of the abdominal muscles. M. Chrestien, of Montpellier, in France, speaks very strongly of the favourable influence of the extract of belladonna, rubbed over the surface of the tumour, in reducing the strangulated bowel. (*Arch. Gén.*, Dec. 1865, p. 743.)

Under the impression that *vomiting in pregnancy* is sometimes caused by irritation from a spasmodic contraction of the uterine fibres, resisting the expanding growth of the fœtus, Bretonneau was induced to employ friction with the extract over the hypogastric region, and met with great success. It is unnecessary to admit his theory of the influence of the medicine, which may relieve other disorders of the uterus besides constriction of its fibres, and thus obviate sympathetic irritation elsewhere; but the fact is important. Its accuracy is confirmed by the experience of MM. Trousseau and Pidoux; and the late Dr. R. L. Scruggs, of Louisiana, employed the remedy repeatedly, with uniform success. He also succeeded, by the same method, in relieving an obstinate and distressing cough, apparently dependent on irritation from the impregnated uterus. (*South. Journ. of Med. and Phys. Sci.*, i. 318.)

3. *To Stimulate the Nervous Centres.*

In reference to this indication, belladonna has been used in certain conditions of *paralysis* with asserted success, particularly in *paraplegic cases*. It is quite obvious that it should never be employed in cases dependent on congestion, inflammation, or organic lesion of the nervous centres, until this condition shall have ceased entirely, and nothing is left but mere inertness. In paralysis combined with neuralgic pains, as in *lead palsy*, we may readily conceive that the medicine may act favourably. In *amaurosis*, moreover, it is said to have proved useful; but here also the affection should be purely functional to justify its employment.

Belladonna has been used in *insanity*, particularly in its *melancholy forms;* and it is probably useful in cases similar to those in which opium proves advantageous, but it is so much inferior to that narcotic, that unless some special objection to opium may exist, it would scarcely be worth while to employ it. When complicated, however, with neuralgic pains, the disease would present a much stronger indication.

In *delirium tremens* it has been used like most other narcotics; but, as it has little tendency to produce sleep, which is the great object aimed at here, it would not seem to be specially called for. In this complaint the pupils are often very much contracted; and belladonna has been suggested as an appropriate remedy, because one of its most constant effects is to dilate the pupil. Dr. James Grieve, of Dumfries, Scotland, has used it locally to expand the pupil, and thus to obviate spectral illusions which he supposed might be connected with this condition of the iris. I tried it in one instance, with no satisfactory result. Besides, one of the characteristic effects of belladonna, when given largely, is to produce illusions.

Under this head we may introduce a notice of the use of belladonna in the *nocturnal incontinence of urine of children.* There can be no doubt of its frequent usefulness in this affection. It should be given at bedtime, and continued for a week or two before being relinquished if unsuccessful. If it prove efficacious, it should be persevered with for some time after apparent cure, in order to break up the habit. It probably acts either by giving greater energy to the sphincter through the nervous centre which regulates its action, or by rendering it, through a congestive influence on the centre, insensible to irritant impressions. A similar efficacy has been claimed for the remedy in *fecal incontinence* occurring in children. (*Bulletin Gén. de Thérap*, Août 15, 1855.)

Upon the same principle of its action on the nervous centres, must be explained its asserted influence in preventing the very serious reflex injuries following extensive burns.

4. *In Reference to its Influence upon the Eye.*

Belladonna is employed in affections of the eye with two objects; one to *diminish the sensibility of the retina* or optic nervous centre, and the other *to dilate the pupil.* With the first object, it may be employed in that not uncommon condition of the eye, in which, altogether independently of inflammation, *light is extremely painful to it*, and, though the vision is in no degree impaired, the use of the organ for any length of time is impossible, in consequence of the pain induced. It has also been advised in the similar sensitiveness which attends *ophthalmia;* though its appropriateness, in the latter condition, is more equivocal.

For the *dilatation of the pupil* belladonna is much used by the surgeons. It is the local application of it that is resorted to for this purpose. The infusion of the leaves, or solution of the extract may be dropped into the eye, or the extract itself, mixed with a little water or lard, may be rubbed upon the eyelids and around them. By many atropia is preferred for the purpose on account of cleanliness. The dilatation usually begins in about half an hour, is at its height in three or four hours, and may continue one or two days or longer.

The objects in producing dilatation with it are manifold. *Before the operation for cataract*, it is useful by removing the iris out of the way; and, *after the operation*, has been recommended, in order to prevent the adhesion of the iris and obliteration of the pupil, which might result from inflammation of that membrane. In operations which involve a *wound of the iris*, it is supposed to be indicated upon the same score. It is said that even in *partial or complete obliteration of the pupil already produced*, if recent, the remedy will obviate the evil by causing a separation of the adhesions while still soft. In *iritis*, either exclusive, or attendant upon conjunctivitis, it has been recommended with the same view of obviating obliteration of the pupil. In cases of *commencing cataract*, it is sometimes temporarily serviceable by bringing within reach of the light the yet unaffected portions of the lens nearest the circumference. In *opacity of the cornea*, moreover, in which vision is obstructed by the position of the opacity immediately before the pupil, it occasionally restores sight for a time by dilating that orifice, so that the light passing the transparent parts of the cornea may enter it.

Belladonna has been used for other purposes besides those mentioned. It has been recommended in *scarlet fever*, both as a *remedy* and *prophylactic*. I have no confidence in its efficiency in either capacity. Its use was suggested by the originator of the homœopathic delusion, upon the basis of one of his dogmas, that diseases are cured by remedies the effects of which resemble the disease itself. Belladonna causes dryness and irritation of the fauces, and sometimes a rash like that of scarlet fever; therefore it is the appropriate remedy for that complaint. If it be capable of acting remedially, it is probably capable also of preventing the disease. Such is the *rationale* of its use. Though I would accept a useful fact from the homœopathists, or any other class of men whatever, or from any source whatever, I should be disposed to subject it to a close scrutiny before admitting its claims to be a fact. I think that many in our profession have been somewhat too hasty in adopting this scion of a false hypothesis. It is true that, in many instances, numbers of children to whom belladonna has been administered, have escaped scarlatina though exposed to the cause; but nothing is more common than a similar result where belladonna has not been given. Every one knows, who has seen much of this disease, that it is extremely capricious in its choice of subjects, sometimes attacking all the children of a family, and not unfrequently seizing upon one only of a large number equally exposed to the cause; so that the exemption, under the circumstances referred to, might well have taken place, though no preventive had been used. Besides, numerous trials have been made by persons quite as deserving of credit, in which the use of belladonna has entirely failed in securing the desired exemption, which could not have happened were it possessed of the power ascribed to it. The mistake might be a very fatal one, if, in reliance upon the prophylactic virtues of belladonna, other means of securing exemption, such as common sense would suggest, should be neglected.

The medicine is asserted to possess antaphrodisiac properties, and to be useful in priapism, chordee, and other irritated conditions of the sexual organs. It probably operates here, like other narcotics in the secondary stage of their action, by diminishing the sensibility of the nervous centres.

Another application made of belladonna is to arrest the secretion of milk, when the infant is from any cause withdrawn from the breast. For this purpose a solution of the extract, or an ointment made by rubbing it with lard, may be applied to the areola and around it. The distended and painful breast is said to be thus greatly relieved, and the practice has been extensively adopted. But the remedy is by no means uniformly efficient (*Bost. Med. and Surg. Journ.*, lviii. 487, and lix. 80); and a case has been recorded in which serious poisoning was produced by the application made to an abraded breast (*Lancet*, Nov. 11, 1865, p. 536). Care, therefore, must be taken that the extract should be used in this way only when the cuticle is unbroken.

The local application of belladonna in the form of tincture, or of liniment made with the extract and lard, has been recommended by Mr. Cooke, of Scarborough, England, as affording great relief in *erysipelas, inflamed chilblains, boils,* and *carbuncles.* (*Med. Times and Gaz.*, July, 1858, p. 126.)

Another local application of belladonna which has been recommended is for the relief of the tenesmus of dysentery. For this purpose the extract or atropia may be used, in the form of a suppository made by incorporating it with cacao butter.

4. *Administration.*

After what has been stated above, little remains to be said on this point. Belladonna may be given in substance, infusion, extract, or tincture; and there are two officinal preparations intended exclusively for external use, namely, the plaster and ointment. Atropia is also among the officinal preparations.

The commencing dose of the powdered leaves is one or two grains, to be repeated two or three times daily, and to be gradually increased until the effects of the medicine are produced. When the leaves have not been injured by time, ten or twelve grains daily can rarely be exceeded without inconvenient effects.

The *Infusion* may be prepared by macerating a scruple of the dried leaves in ten fluidounces of boiling water. The dose at first is one or two fluidounces two or three times daily, to be increased as in the case of the powder.

The medicine, however, in this country is much more used in the form of extract than in any other way. The U. S. Pharmacopœia directs two extracts, one of which is the inspissated juice, and the other is prepared by means of diluted alcohol.

EXTRACT OF BELLADONNA.—EXTRACTUM BELLADONNÆ. *U. S. Br.*

This is prepared by bruising the fresh leaves, expressing the juice, heating this to the boiling point so as to coagulate the albumen, then straining, and evaporating the clear liquor to the proper consistence. It has a dark-brown colour, a narcotic not disagreeable odour, a bitterish taste, and a soft consistence. As used in this country it is generally imported, and is of unequal strength, sometimes very powerful, sometimes feeble, and therefore requiring to be administered with much caution. Special care must be taken that, in increasing the dose, the same parcel should be employed; and if a new one is to be used, the dose should be reduced so as to test its strength. This is the preparation most employed in the United States. The commencing dose is from one-quarter to one-half a grain, twice or three times a day, gradually increased, if necessary, until some sign of its action is produced, as dryness of the throat, dimness of vision with dilatation of the pupil, or uneasy sensation in the head. I have often known half a grain to act decidedly.

In the way of enema not more than three times as much should be given as by the mouth. For endermic use, three or four grains may be employed, but its effects should be watched. If no effect is produced, the quantity may be increased. For friction on the sound skin, from ten to thirty grains or more may be used, with sufficient water to bring it to the consistence of thick cream, or with twice its weight of lard.

ALCOHOLIC EXTRACT OF BELLADONNA.—EXTRACTUM BELLADONNÆ ALCOHOLICUM. *U. S.*

The *alcoholic extract* is prepared by evaporating a tincture of the leaves made with diluted alcohol. The dose is half a grain to begin with.

TINCTURE OF BELLADONNA.—TINCTURA BELLADONNÆ. *U. S., Br.*

This is made in the proportion of four ounces of the dried leav two pints of diluted alcohol. It is an efficient preparation, if made from recently dried leaves. The dose is fifteen or thirty drops, or half the number of minims, to be increased as the other preparations.

Not more than one-sixth or one-eighth of the doses above mentioned should be given at first to a child two years old.

PLASTER OF BELLADONNA.—EMPLASTRUM BELLADONNÆ. *U. S., Br.*

This is prepared by incorporating the extract (alcoholic extract, *U. S.*) with melted resin plaster. It is used, spread upon coarse linen or leather, in rheumatic pains, neuralgia, dysmenorrhœa, etc. I have known the system to be affected by it; and a case is on record in which even alarming symptoms resulted from the application of this plaster to a surface covered with an eruption, and partially ulcerated.

OINTMENT OF BELLADONNA.—UNGUENTUM BELLADONNÆ. *U. S., Br.*

This consists of one part of the extract and eight of lard mixed. It is used for friction upon the skin, or as a dressing to blistered surfaces. For the latter purpose, not more than half a drachm or two scruples should be applied at first.

LINIMENT OF BELLADONNA.—LINIMENTUM BELLADONNÆ. *Br.*

This is a very concentrated tincture of the root of belladonna, intended exclusively for external use. It may be applied by means of a camel's-hair pencil, or may be diluted with two or more measures of soap liniment, and rubbed upon the part. It is peculiar to the British Pharmacopœia.

ATROPIA. *U. S., Br.*

This is thought to exist in belladonna, combined with malic acid in excess. For an account of the different somewhat complex processes by which it is extracted, the reader is referred to the U. S. Dispensatory. Mr. W. T. Luxton, of London, proposes the following simple method. To a decoction of the leaves he adds a little concentrated sulphuric acid, which precipitates the albumen and forms sulphate of atropia; then, having drawn off the clear liquor, he precipitates the atropia either by solution of ammonia, or the sesquicarbonate of that alkali. After a day or two the clear liquid is drawn off, and the crystals which have formed, having been thrown on a filter to dry, are washed with a little spirit of ammonia, which deprives them of most of their colouring matter, leaving them "moderately" white. He has thus generally obtained about 5.5 parts from 1000 of the leaves, while the process usually employed yields only 3 parts for 1000. (See *Am. Journ. of Pharm.*, xxvii. 156.)

Atropia is in white, translucent, silky, acicular crystals, inodorous, of a bitter acrid taste, slightly soluble in cold water, considerably more so in ether, very soluble in alcohol, and dissolved by all these liquids in larger proportion when hot than cold. It melts with heat, and at a higher temperature is dissipated, part being volatilized without change, and the remainder decomposed. It has an alkaline reaction with litmus-paper, and neutralizes the acids, forming crystallizable salts with the sulphuric, muriatic, and acetic. Nitric acid dissolves it, forming a yellow solution; sulphuric acid dissolves it without change of colour if cold, but when hot reddens it. Like the other organic bases, it is precipitated by the alkalies from its saline solutions, unless very feeble; and from the same solutions tannic acid throws down the tannate of atropia. Like most of these, too, it consists of carbon, hydrogen, oxygen, and nitrogen.

The effects produced upon the system by atropia are exactly those of belladonna, only that they occur more promptly and are relatively much more powerful. Thus the alkaloid gives evidence of its operation in twenty minutes, while the powdered leaves or extract usually require half an hour. Its action continues from twelve to twenty-four hours or longer. One-sixth of a grain, taken into the stomach, generally produces symptoms of a somewhat violent character, as accelerated pulse, dryness and stricture of the throat, dimness of vision, with dilated pupil, giddiness, abnormal sounds, phantasms, delirium, and sometimes numbness and tingling of the extremities, and strangury, with depression of the circulation and temperature of the surface. Two-thirds of a grain have occasioned the most alarming symptoms, from which, however, recovery took place.

For *internal use* it has little advantage over the other preparations, while, from its small bulk, it might be more liable to be taken in poisonous quantities. Nevertheless, if pure, it may be more certainly depended on in a given dose, and danger may be avoided with care. It is applicable to the same diseases precisely as belladonna itself. The dose at first should never exceed the twelfth of a grain; and it would be best to commence with the twenty-fourth or thirtieth, which may be repeated two or three times daily, and increased if requisite.

Externally, especially for application to the eye, it is preferred by some to the extract, in consequence of the less quantity required, and its greater cleanliness. It may also be used with great effect *endermically*. It is chiefly employed to dilate the pupil, which it does very promptly, in exceedingly minute quantity. One drop of a solution, containing only a grain in a fluidounce of the menstruum, will produce the effect. M. Streatfeild recommends for this purpose the use of *atropia paper*, which may be made by saturating paper with the solution just mentioned, in such a way, that a little piece, about one-fifth of an inch square, shall be wet with exactly one drop of the solution. The paper is then dried, and, when wanted, may be applied by drawing down the lower lid, and placing the piece of paper upon the ball beneath the cornea. (*Ann. de Thérap.*, 1864, p. 33.)

Atropia has also been used *hypodermically* for the relief of neuralgic affections. Its use in this way has greatly extended of late; and it has been employed in most other complaints in which belladonna has been thought to be useful. It seems to have been peculiarly efficacious in severe rheumatic pains of a subacute character, but of considerable duration, especially sciatica. One-twenty-fourth or one-sixteenth of a grain, dissolved in from fifteen to thirty minims of water, may be injected into the subcutaneous areolar tissue at one operation; but some cases of unexpected violence from its use in this way have led to peculiar caution in regard to the hypodermic dose; and it is now recommended not to administer by injection, at the first operation, more than one-half the quantity administered by the mouth. It is not improbable that, in the cases where alarming effects have been suddenly produced, the solution may have been injected directly into a punctured vein. To avoid such a result, the point of the instrument may be very slightly drawn back before the liquid is injected. A case is on record in which the $\frac{1}{190}$ of a grain produced apparently serious effects.

The British Pharmacopœia directs a *Solution of Atropia* (LIQUOR ATROPIÆ, *Br.*), made by dissolving four grains of the alkaloid in a fluidounce of a menstruum consisting of seven fluidrachms of distilled water and one of rectified spirit. Four minims, equivalent to one-thirtieth of a grain of atropia, may be given as a commencing dose, and increased if necessary to ten or twelve minims. Half the quantity may be used for subcutaneous injection. Diluted with four measures of distilled water, it may be used for dilating the pupil.

An *Ointment of Atropia* (UNGUENTUM ATROPIÆ, *Br.*) is also officinal in the British Pharmacopœia, made by first dissolving eight grains of atropia in half a fluidrachm of rectified spirit, and afterwards mixing the solution with one ounce (avoirdupois) of prepared lard. In the application of this ointment, care must be taken that it do not come in contact with wounded, abraded, or ulcerated surfaces.

The U. S. Pharmacopœia directs the *Sulphate of Atropia* (ATROPIÆ SULPHAS, *U. S.*); but it has little advantage over the pure alkaloid, which may be dissolved in water with the utmost facility by means of a little acetic acid. *Valerianate of atropia* has also been recommended as peculiarly efficacious in asthma; but the dose of valerianic acid is so controlled by that of atropia that it can scarcely exercise any observable influence. The following preparations may be made for use. Dissolve one grain of atropia in a fluidrachm of alcohol, and add seven fluidrachms of distilled water to the solution; or mix a grain with a fluidounce of pure water, and drop in diluted acetic acid till the solution is effected. Of either of these preparations, fifteen minims may be given for a commencing dose, and a drop or two may be introduced into the eye in order to dilate the pupil. An ointment may be made by rubbing up five grains thoroughly with three drachms of lard; of which a portion about as large as a pea may be used in friction to the eyelids and face, to dilate the pupil, or relieve neuralgia. Another method is to paint the eyelid with a solution of atropia in a chloroformic solution of gutta percha. When atropia is applied to a blistered surface, or that of an ulcer, not more than the dose given by the mouth should be used at first, in consequence of its very rapid absorption. It causes when thus employed a slight pain, which soon ceases. A case of fatal poisoning is said to have occurred from the application to a blister on the neck of an ointment composed of 15.5 parts of sulphate of atropia and 700 parts of lard. (*Pharm. Journ. and Trans.*, June, 1865, p. 664.)*

---

* *Atropia and Morphia.* Some interesting results have been recently obtained in regard to the physiological action of atropia, and of its relation with the alkaloid of opium. A series of observations on these points were undertaken, under favourable circumstances, jointly by Drs. S. Weir Mitchell, Wm. W. Keen, and Geo. R. Morehouse, of Philadelphia, which eventuated in the following conclusions; and these correspond very closely with the results of similar inquiries made about the same time by Dr. Da Costa, of this city, and subsequently by Dr. Erlenmeyer, of Bendorf, in Germany. In the experiments of Dr. Mitchell and his coadjutors, the alkaloids in solution were injected into the subcutaneous areolar tissue; the morphia, in the form of sulphate, in doses varying from one-third to one-fourth of a grain; the atropia, from one-fifteenth to one-thirtieth.

1. *Circulation and Respiration.* On the circulation, the first effect of atropia was for a few minutes either nothing, or a slight diminution in the frequency of the pulse; but uniformly this short period of quiescence or diminution (from 4 to 10 minutes) was followed by excitement; the pulse rising from 15 to 40 beats in a minute, continuing thus about an hour, then gradually subsiding till, after about 4 hours, it fell considerably below the natural standard. The greatest depression was in the tenth or eleventh hour, after which it rose again, and became normal in 24 hours. The respiration did not increase in frequency with the pulse, but either remained unaltered, or was slightly depressed.

After the injection of *morphia*, the pulse was not strikingly affected. In a few cases it rose slightly, in a larger number it was unchanged, and in a still larger number fell an average of 8 beats only; but the fulness was increased with the general influence of the morphia. The respiration was little affected. The general conclusion was that morphia subcutaneously administered, in ordinary remedial doses, has no conspicuous influence on the heart and lungs.

When the two alkaloids were administered conjointly, the result was precisely the same on the pulse and respiration as when the atropia was given alone; that is, its action was in no degree modified by the morphia.

The inference is that, in relation to the functions of circulation and respiration, there is no antagonism between atropia and morphia.

2. *Action on the Eye.* In their action on the eye, the alkaloids appeared, to a certain extent at least, to neutralize each other. When the pupil was dilated with atropia, the injection of morphia caused it, within half an hour, either to return to the normal standard, or to contract still further. So also with the power of accommodation, which, however, oftener remained paralyzed for an hour or more after the pupils began to show the influence of morphia; so that in this respect the opiate

IX. STRAMONIUM.

Datura Stramonium, thornapple, or *Jamestown weed*, is an annual plant from two to six feet high, growing in all quarters of the world, and flourishing especially in rank soil, as on dung-heaps, and on the road-sides and commons near towns and villages, where refuse matter is apt to be collected. Its original native country is uncertain. It is often clustered in patches, and scents the air of the neighbourhood with its disagreeable odour. All parts of it are active. The U. S. Pharmacopœia recognizes the leaves, seeds, and root.

1. STRAMONIUM LEAF.—*Stramonii Folium.* U. S.—*Stramonii Folia.* Br.—These have short footstalks, are five or six inches long, unequal at the base, irregularly sinuated and notched at the border, dark green above, and pale beneath. When fresh and bruised, they have a fetid, narcotic odour, which they lose by drying; retaining, however, a bitter and nauseous taste.

2. STRAMONIUM SEED.—*Stramonii Semen.* U. S.—*Stramonii Semina.* Br.—These are small, kidney-shaped, flattened on the sides, of a blackish-brown colour, without smell, and of a bitter, nauseous, some-

---

alkaloid seemed to be less powerfully antagonistic than in reference to the pupil. The general conclusion, however, was that the two alkaloids neutralized each other in their action both on the retina and the ciliary muscle.

3. *Cerebral functions.* Here there was found to be a decided antagonism in some points. Thus the headache, phantasms, visual disorder, and deafness caused by atropia were lessened or disappeared under the influence of morphia; while the drowsiness and stupor of the latter alkaloid were controlled by the former. The pallor of morphia and the flush of atropia were also mutually modified.

4. *Other actions.* The nausea often caused by morphia was not diminished by atropia.

The effects of the two alkaloids on the mucous membrane coincided; but the property of inducing dryness in the throat was greater in atropia.

In producing dysury, they appeared to concur.

The influence of morphia in the relief of pain was not disturbed by atropia.

According to the same experimenters, neither *atropia, daturia,* nor *conia,* has any power of lessening pain when administered hypodermically. In this respect, however, the conclusion of the authors does not coincide with that of many others, who have found great relief to painful affections from the subcutaneous injection of atropia. Dr. Erlenmeyer states that the atropia and morphia given jointly, will, in many cases of neuralgia, succeed perfectly, after entire failure with both administered separately. (*Arch. Gén.*, Mars, 1866, p. 362.)

From all these results it may be inferred that, while a certain degree of antagonism exists between atropia and morphia on some points, in others they coincide or are indifferent; and therefore that it would be unsafe to rely upon either exclusively in poisoning by the other; though they may be employed to meet certain indications. (See *Am. Journ. of Med. Sci.*, July, 1865, p. 67.)—*Note to the third edition.*

what acrid taste. They are stronger in medicinal qualities than any other part of the plant.

3. STRAMONIUM ROOT. — *Stramonii Radix.* U.S. 1850. — This is large, whitish, branched, with numerous fibres, fleshy when fresh, light and spongy when dry, and of very little smell or taste, though it leaves a slightly acrid impression in the mouth when chewed.

All these parts yield their virtues to water and alcohol.

Active Principle. The odour of the plant would suggest that the volatile principle might possess narcotic properties; but it is asserted that water distilled from the fresh leaves, though it has their odour in some degree, is without effect on the system; and the seeds, which are inodorous, are stronger than the leaves. It is probable that the virtues of the plant reside exclusively in an organic alkali, which has been extracted from the seeds, and received the name of *daturia.* In its sensible, chemical, and physiological properties, this bears so close a resemblance to *atropia* as to have led to the supposition that the two principles are identical; and if their composition be, as stated by Von Planta, precisely the same, the supposition must be considered as correct. Upon this ground we can explain the extraordinary resemblance of stramonium and belladonna in their effects upon the system, and their remedial application. Daturia, like hyoscyamia and atropia, is rendered inert by admixture with even a weak solution of caustic potassa or soda, but is not affected by their carbonates.

Effects on the System. The operation of stramonium on the system so closely resembles that of belladonna, that it is necessary to do little more than refer to the account of the latter medicine. (See *page* 785.) It is sufficient to say, in reference to the effects of stramonium in full medicinal doses, that it produces dryness and uneasy sensations in the throat, dimness or perversion of vision, sometimes dilatation of the pupil, not unfrequently vertigo, headache, mental confusion or slight delirium, and, in some rare instances, sleep; and that its operation on the brain is attended with little or no disturbance of the circulation, and no tendency to constipation, but with an occasional increase of perspiration or urine. In poisonous quantities, it causes great uneasiness of the throat with a feeling as of strangulation, anxiety and faintness, partial or complete blindness, great dilatation of the pupil, sometimes deafness, flushing of the face, vertigo, headache, hallucinations, delirium of a whimsical, ludicrous, or more rarely furious character, tremors, paralysis, and at last stupor, with convulsions in rare instances. There is usually, in the advanced stage, great prostration, as indicated by the very feeble pulse, and cool skin; and sometimes the local irritant influence of the poison is evinced by a burning pain at the stomach, nausea, and vomiting. From the worst symptoms mentioned, recovery has often taken place; but not unfrequently they have ended fatally, in a period varying from six to twenty-four hours. In case of recovery, the poisonous symptoms are of variable duration, but generally begin to disappear within twenty-four hours; and the patient, upon rising out of his lethargy, has no recollection of what has passed. Little definite is known, as to the smallest quantity that may cause death. A child two years old was killed by 100 seeds, which were swallowed whole, and were afterwards found in the stomach and bowels. Dr. Young states that a single capsule with its contents proved fatal to a child. It is the seeds which are most frequently taken in poisonous quantities, and generally by children, who gather them from the plant. Stupor in a child, with extraordinarily dilated pupil, should lead to the suspicion of this kind of poisoning, if access to the cause was possible. The late Dr. Dorsey used, in his lectures, to relate a case in which this symptom induced him to suspect narcotic poisoning, and, upon this suspicion, to administer an emetic, which caused the discharge of numerous stramonium seeds, with the effect apparently of saving life. Alarming symptoms have followed the external application of the leaves to a burn.

Herbivorous animals are less affected than man. Five ounces of the fresh juice produced only slight drowsiness in a horse; and two pounds and a half of the seeds, given to another horse, though they proved fatal, did not destroy life until after fifty-two hours. (*Pereira's Mat. Med.*) Upon dogs the poison acts as in the human subject.

The treatment of poisoning by stramonium is the same as that for opium. Animal charcoal may be given at the same time, as an antidote to the poison remaining in the stomach.

Like belladonna, stramonium produces its peculiar effects, no matter to what part of the body it may be applied; and, in like manner, the expressed juice, an infusion of the leaves, or the extract dilates the pupil, when introduced into the eye, or rubbed upon the eyelids and neighbouring parts. There is little doubt that it acts on the brain exclusively through the blood.

Therapeutic Application. This medicine is not known to have been employed, before it was introduced to the notice of the profession by the famous Störck, who used it in insanity, chorea, and epilepsy. It is capable of fulfilling the same indications as belladonna; that is, to relieve pain, relax spasm and muscular rigidity, stimulate the depressed cerebral centres, diminish the susceptibility of the retina, and dilate the pupil. There is not, perhaps, one of the therapeutic uses of belladonna, in reference to which stramonium might not be substituted for it, with the same or very similar results. The following, however, are the diseases in which it has actually been employed, with more or less supposed success; namely, *neuralgia, syphilitic pains, rheumatism and gout, dysmenorrhœa, painful tumours and ulcers, tetanus, epilepsy, hooping-cough, spasmodic asthma, puerperal convulsions, mania, de-*

lirium tremens, and *nymphomania* It is also occasionally used by American oculists to *dilate the pupil*. To enter into a minute account of its uses in each of these affections, would be merely to repeat what has been said under the head of belladonna; and I must content myself with referring the reader to the article on that subject. But the use of stramonium in asthma deserves a more particular consideration.

The smoking of the root of *Datura ferox*, in *the paroxysms of asthma*, has long been a common practice among the natives in the East Indies. An English general officer, having derived great benefit in his own case from the remedy, was induced, on his return to England, to try the effects of the common stramonium, which he found to answer the same purpose. The remedy, having been made known, was soon extensively employed, and received the highest commendation from various respectable sources. Objection, however, was afterwards made to it, on the score that it endangered disease of the brain, and had frequently caused mischievous results. The same may be said of every active remedy. In its application to asthma, stramonium requires to be judiciously employed; but, with proper precautions, there is little or no danger; and the greatest benefit may often be obtained. In dyspnœa arising from organic disease of the heart or lungs, it can generally be productive of little good, and should not be employed unless to alleviate the affection, when dependent, not on congestion of the pulmonary organs, but on mere nervous irritation connected with the disease. Neither is it adapted to cases of gouty asthma, in which there is a disposition to translation from one organ to another, and especially, when experience has shown that there is any tendency of the disease to the brain. In such cases, by stimulating the cerebral centres, the medicine renders them a point of afflux for the gouty irritation, which may fix upon them with great violence; and, though the patient may be relieved of the dyspnœa, he is liable to die of coma. But in the pure spasmodic asthma, unconnected with any other organic disease than such as has been induced by the asthma itself, as emphysema of the lungs, for example, the smoking of stramonium is often extremely useful, and, if care be taken not to carry it too far, is perfectly safe. It is applicable only to the paroxysms, and should be confined to these, lest its influence should wear out too rapidly. The relief afforded by it is sometimes immediate and entire; the patient falling quietly to sleep, not because of the soporific effect of the remedy, but in consequence of the removal of the cause of his wakefulness. It does not prevent subsequent paroxysms, and will not cure the complaint, which, after being completely established, is seldom cured by any means that can be employed; but it is an object of great importance to mitigate the sufferings of the patient, and prolong his life, as probably may be done by preventing the rapid increase of emphysema, which is the inevitable result of the excessive dyspnœa. Unfortunately the remedy has not been found equally effectual in all cases of the disease; and, even in those in which it at first operates most effectually, though it may continue to yield relief for years, yet its influence gradually diminishes; so that at length it sometimes ceases to be felt. It is said that General Gent, who was most instrumental in introducing the remedy into England, at last suddenly died with coma from the effects of it, probably owing to his over-confidence. Either the root or the dried leaves may be used. The former should be quickly dried, cut in pieces, and beaten so as to render its texture loose. Fifteen grains may be smoked at once, and the pipe may be renewed several times a day, if necessary, care being taken to stop when any decided narcotic effect is produced. The leaves may also be used in the form of a cigar; and, as in the case of belladonna, they may sometimes be advantageously impregnated with nitre previously to being rolled into the required shape. (See *page* 799.) The smoke is said to cause a feeling of warmth in the lungs, which is soon followed by copious expectoration, and often by some temporary vertigo and drowsiness, and sometimes nausea. In the intervals between the paroxysms, the extract may be taken internally in such doses as moderately to affect the system.

As an external remedy also, stramonium is susceptible of the same applications as belladonna, and may be used in the same way. In the form of cataplasm, or of ointment made with the extract, it has been used in inflamed or painful tumours, irritable ulcers, rheumatism in the joints or muscles, swelled mamma, painful hemorrhoids, and irritating cutaneous affections.

Administration. The dose of the powdered leaves is two or three grains, twice or thrice daily. That of the powdered seeds is one grain, repeated as often. Should this dose produce no effect in a day or two, it should be gradually increased until it gives rise to some evidence of its action, as dimness of vision, dryness and stricture of the throat, etc. Fifteen or twenty grains of the leaves have often been given without unpleasant effects. The medicine, however, is more frequently administered in extract. The U. S. Pharmacopœia directs two extracts, one of which is the inspissated juice of the leaves, and the other is prepared by evaporating a tincture of the seeds.

The *Extract of the Leaves* (EXTRACTUM STRAMONII, *U. S.*) is made by expressing the juice of the leaves, heating to coagulate the albumen, then filtering, and evaporating. The preparation is of unequal strength. The commencing dose is one grain, to be repeated and increased in the same manner as the powder.

An *Alcoholic Extract* (EXTRACTUM STRAMONII ALCOHOLICUM, *U. S.*) is prepared from the leaves, by the U. S. Pharmacopœia, by first forming a tincture by percolation, and then evaporating. The dose is a grain.

The *Extract of the Seeds* (EXTRACTUM STRAMONII SEMINIS, *U. S.*;

EXTRACTUM STRAMONII, *Br.*) is prepared by evaporating a tincture of the seeds. It is a stronger and more equable preparation than the preceding, and may be given in the dose of one-quarter or one-half a grain, to be repeated and increased in the same manner.

The *Tincture of Stramonium* (TINCTURA STRAMONII, *U. S.*, *Br.*) is made from four ounces of the seeds and two pints of diluted alcohol. It is an excellent preparation, and may be administered in the commencing dose of ten minims or twenty drops.

The *Ointment* (UNGUENTUM STRAMONII, *U. S.*) is prepared by simply mixing a drachm of the extract with an ounce of lard; the extract having been first rubbed with half a fluidrachm of water. It may be used for frictions over painful surfaces, as an application to hemorrhoidal tumours, and as a dressing to irritable ulcers.

Daturia, the alkaloid of stramonium, upon which its virtues probably depend, has been used in a few instances for obtaining the effects of the medicine; but its action is so precisely that of atropia that sufficient inducement is not offered for its preparation, and it is comparatively little employed.

CLASS IV.

SPINAL STIMULANTS.

Of all the medicines in common use, only the products of the genus Strychnos belong properly to this class. Some others have a stimulant influence over the spinal functions, but they have also properties which class them elsewhere, and there is no one which approaches in power those here referred to. The products of the two species, *Strychnos Nux vomica* and *S. Ignatia*, are so similar, I might say identical in character, that it is scarcely advisable to consider them distinctly. They are, therefore, united in the following article.

NUX VOMICA

AND

BEAN OF ST. IGNATIUS.

I. NUX VOMICA. *U. S., Br.*

Origin. This name has been given to the seeds of *Strychnos Nux vomica*, a middling-sized tree, growing in various parts of the East Indies. The bark is intensely bitter, containing the same alkaloids which characterize the seeds, and is thought to be identical with a product which at one time attracted considerable attention, under the name of *False Angustura bark.* The seeds are embedded in the juicy pulp of the fruit, which is a round berry, about the size of an orange, and covered with a smooth, yellowish, or orange-coloured rind.

Properties. The seeds are circular, about three-quarters of an inch in diameter and two lines thick, somewhat concave on one side and convex on the other, externally presenting a thin coat closely invested with very short, silky, ash-coloured hairs, internally whitish, translucent, very hard and tough, and difficult to pulverize. They are inodorous and intensely bitter, and yield their bitterness and medical virtues to water, but more readily to diluted alcohol.

II. BEAN OF ST. IGNATIUS.—FABA SANCTI IGNATII.—IGNATIA. *U. S.*

Origin. This is the seed of *Strychnos Ignatia*, the *Ignatia amara* of the younger Linnæus, a tree of moderate size, growing in the Philippine Islands. The seeds are embedded in the dry pulp of a fruit resembling a pear in size and shape.

Properties. The bean of St. Ignatius is about an inch long, of less thickness, convex on one side, obscurely angular on the other, of a pale-brown colour, externally covered with a very short down, internally translucent, hard, and horny. In its sensible properties of odour and taste, and its relations to water and alcohol, it is closely analogous to nux vomica.

Active Principles. Both nux vomica and the bean of St. Ignatius owe their medicinal virtues mainly to two alkaloids, denominated *strychnia* and *brucia;* and claims have been advanced to the discovery of a third, to which the name of *igasuria* has been given. These bases are supposed to exist naturally in combination with a peculiar acid, called *igasuric* or *strychnic.* The alkaloids differ greatly in strength, strychnia being estimated as having at least twelve times the strength of brucia, and igasuria being intermediate. For practical purposes, strychnia may be considered as the active principle, and is the only one much used in an isolated state. Though similar in virtues, nux vomica and bean of St. Ignatius probably differ greatly in power; at least, the latter contains a much larger proportion of strychnia than the former; the percentage of that alkaloid being given at 0.4 in nux vomica, and 1.2 in the bean of St. Ignatius.

Incompatibles. Alkalies, their carbonates, and alkaline earths, and the vegetable astringents, throw down precipitates from watery solutions of these medicines, the former separating the insoluble alkaloids, the latter forming insoluble tannates; but, if the precipitated matter is swallowed, it is capable of acting energetically, though probably somewhat more slowly than the solution.

1. *Effects on the System.*

The effects of nux vomica, in small doses, are those of a bitter tonic, combined, when the quantity taken is sufficient to affect the system, with an influence on the nervous functions which is quite peculiar, and which, in its higher degrees, is so violent and dangerous as to give the medicine a place among the poisons.

From very small doses no effects are at first experienced; but, if repeated every six or eight hours, they will be found in the course of a day or two to increase the appetite, hasten the digestion, and act generally the part of a simple tonic; and, by carefully managing the dose, diminishing it, or suspending the medicine for a time when the slightest sign of its peculiar action upon the nervous system is evinced, the effects may be confined within the tonic limits. Often, however, there will be some increase of the urinary secretion, with more frequent micturition; and it is said that the medicine sometimes proves diaphoretic or laxative. In large doses, its operation upon the stomach becomes irritant, causing loss of appetite, epigastric uneasiness, cardialgia, and sometimes vomiting or purging.

When it is taken more largely than requisite for the tonic effect, an entirely new series of phenomena are developed. The first observable effect in this series is generally a feeling of stiffness or stricture in the muscles of the jaw, or at the back of the neck, or of weight or weakness with trembling of the limbs. Some resistance is apparently felt in opening the mouth widely; there is difficulty in taking a full inspiration; and after a time the feeling of stiffness may be experienced more or less elsewhere, upon any attempt at movement. Along with this symptom, there is an increased sensitiveness to external impressions, especially of the touch; so that a slight tap upon the skin will produce sudden and involuntary startings of the muscles; and twitchings or catching movements in the limbs are not unfrequently the first symptom which attracts particular notice. If, under these circumstances, the individual try to walk, there will be a sense of tottering or staggering, not from vertiginous feelings, but as if from want of power to regulate the action of the muscles. After some days there is often a feeling of formication, tingling, or itching on different parts of the surface, such as is commonly felt when the foot is said to be asleep. Sometimes this sensation is among the earliest phenomena; and it is occasionally so severe as to constitute the most prominent symptom. An eruption upon the skin has been noticed in some instances.

Under a somewhat more energetic influence of the medicine, the spasmodic startings become more frequent and severe; horripilations and shiverings, with darting sensations like electric shocks, are not unfrequently experienced; and the muscular stiffness increases and extends, so that the patient complains not only of rigidity of the limbs, but also of tightness about his throat, difficulty of deglutition, stricture of the chest and abdomen, and even involuntary erections of the penis; those muscles now becoming affected which belong but partially to the voluntary class.

With the powerful effects upon the nervous system above referred to, the circulation is little affected; the pulse being often slow and natural; and when accelerated, as sometimes happens, it is so, in all probability secondarily. The brain, too, is usually undisturbed; the mental functions being quite sound; though occasionally there may be temporary [illegible] of pain in the head, vertigo, tinnitus aurium, contraction or dilatation of the pupils, and sparkling or dimness of vision. A tendency to drowsiness or stupor has also been observed in some rare instances.*

Poisonous Effects. Beyond the condition above described, the effects of the medicine become poisonous. The spasms are more frequent, extensive, and severe, sometimes involving almost the whole frame, and are attended with a tetanic rigidity which is probably the most characteristic symptom. The attacks come on suddenly, like electric shocks, last usually from a quarter of a minute to two or three minutes, and, after a longer or shorter interval, seldom exceeding ten minutes, recur with increased violence, and at last, if not relieved, with fatal effect. If the patient is seized with them when attempting to walk, he staggers and falls. During the spasms, the muscles affected feel hard like a board, and different parts of the body are drawn fixedly into various abnormal positions, from which they cannot be removed. Thus, the head may be thrown backward, the jaws firmly closed, the face distorted, the arms or lower limbs extended outward, the hands clenched, the toes flexed, and the trunk bent backward, forward, or to either side, or stiffly erect. The respiratory muscles become involved, and the breathing is hurried or imperfect, and temporarily suspended, with a purple hue of the face, lips, and extremities, coolness of the surface, and a pulse which is sometimes slow, sometimes quickened, but always feeble, and occasionally almost or quite imperceptible. In some instances, there are involuntary discharges of urine or feces. The attacks are often brought on by very slight causes affecting the surface, as by a fresh contact of the bedclothes, or a gentle touch with the finger. As in tetanus and hydrophobia, an attempt to swallow, or even the idea of swallowing, will sometimes induce spasms of the respiratory muscles.† The spasms are often attended with a violent shivering or tremulous movement through the body; and the muscles may be felt vibrating as it were under the hand. Sometimes the patient, when asked if he has suffered pain in the spasms, answers in the negative; in other instances, they are more or less painful, and in others, again, extremely so. In the intervals, there is often a feeling of trepidation, alarm, or anxiety strongly expressed on the countenance; the stomach is sometimes nauseated; the pulse is feeble and often agitated, or even fluttering; and the patient complains of thirst, sweats profusely, and, after a severe attack, has a feeling of fatigue and exhaustion. At length, in one of the spasmodic attacks, respiration is quite arrested, the pulse ceases to beat, and the patient dies with asphyxia. The mind is usually clear throughout the case, until near the fatal issue, which is preceded for a short period by insensibility and unconsciousness. When the poisoning has resulted from one large dose, the characteristic symptoms make their appearance from ten minutes to half an hour after it has been taken, and death generally occurs very quickly, sometimes in the course of a few minutes, after the third, fourth, or fifth paroxysm. One instance is on record, in which death followed in fourteen minutes after the poison was swallowed; and from half an hour to an hour and a half is not an uncommon period. Under other circumstances, the poisonous phenomena may be developed much later, and the termination be much longer postponed. When the case is to end favourably, which not unfrequently happens, there is a gradual subsidence of the violent symptoms; but more or less rigidity may linger for a day or longer; and soreness of the muscles, as if they had been bruised, is felt after other symptoms have ceased.

---

* See remarks by W. G. Thomas, M.D., in the *N. Jersey Med. and Surg. Reporter*, Jan. 1857, p. 3.

† See the account of a case by Mr. Hennel in the *Lond. Med. Times and Gaz.*, April, 1855, p. 414.

After death, the muscles often remain in a state of tetanic rigidity, and there is frequently more or less blueness or lividity about the face, hands, and feet. Internally the ordinary signs of venous congestion are presented, as of persons dying from asphyxia. This is especially observable in the lungs; and the bronchial mucous membrane, as well as that of the stomach and bowels, sometimes exhibits hemorrhagic spots or patches. The heart has in some instances been found firmly contracted, in others quite relaxed, and either empty, or distended with blood. The blood itself has by some examiners been seen coagulated; while by others no clot could be anywhere discovered. Congestion of the brain and its vessels, redness and increased vascularity of the membranes of the spinal cord, patches of extravasated blood in these membranes, and effusion into the spinal sheath have been noticed; and both the brain and the spinal marrow are said to have been found in a softened state; but nothing has yet been discovered by post-mortem examination which can throw a very clear light on the action of the poison. Though evidences of inflammation of the stomach are stated to have been exhibited in several cases, yet in the great majority nothing of the kind has been noticed; and the poisonous effects must, therefore, be quite independent of gastric irritation. The bulk of the spleen has been observed to be strikingly diminished, after death from strychnia in the lower animals. Strychnia may usually be detected in the stomach and bowels if not evacuated or absorbed during life, in the urine if it has had time to pass off by the kidneys, in the blood, and in some of the tissues, especially in the liver; but the absence of any discoverable chemical evidences of strychnia in these positions, though a presumption, should not be considered as a positive proof that the death did not result from the poison.

Quantity requisite for Poisoning. The quantity of nux vomica or of its preparations requisite to destroy life is very uncertain. The suscepbility to its influence is extremely different in different persons. A case is on record in which fifteen grains of the powder are stated to have proved fatal; another in which the same effect was produced by thirty grains in two doses; and in two others, which occurred in 1829 in London, death resulted from fifty grains. (*[illegible] on Poisons*, [illegible].) Yet the last-mentioned quantity has been repeatedly administered without inconvenience; and, as a general rule, the poisonous dose would probably much exceed a drachm. Recoveries have frequently taken place, under proper treatment, after quantities had been swallowed varying from half an ounce to an ounce. As the bean of St. Ignatius contains probably three times as much strychnia as nux vomica, it may be considered as in an equal degree more poisonous. The extract of nux vomica is said to have proved fatal in the quantity of three grains (*Ibid.*); and as M. [illegible] obtained from the seeds an average product of about one-twelfth of extract, this would be equivalent to somewhat more than half a drachm of the powder. The smallest quantity of strychnia known to have caused death in an adult, is half a grain; which is much larger relatively than the smallest fatal doses above mentioned of the powder and extract.

Treatment of Poisoning. The most important point of treatment in poisoning from nux vomica, bean of St. Ignatius, or any of their preparations, is to empty the stomach as speedily and as thoroughly as possible. An active and prompt emetic should be administered immediately. Sulphate of zinc, tartar emetic, or ipecacuanha may be given severally or combined, and their influence may be aided, if necessary, by powdered mustard. During the spasmodic paroxysms it is usually impossible for the patient to swallow, and the jaws are often so firmly closed that medicines cannot be readily introduced into the mouth; but relaxation in general takes place in a short time, and the opportunity thus afforded should be instantly seized for the exhibition of the emetic. Should it be impracticable to introduce the medicine into the mouth, it might possibly be injected through a catheter or other small tube inserted into one of the nostrils. When the stomach pump can be employed, it should be brought in aid of the emetic, so as thoroughly to wash out the poison; but it should not be relied on to the exclusion of the latter remedy, which has often proved efficient. I have been informed of a case in which, after the strongest emetics had been taken without effect, a current of electricity directed through the body at the epigastrium was quickly followed by vomiting, probably in consequence of the susceptibility of the stomach being aroused by the measure. The patient was saved. Unfortunately there is no antidote to strychnia which has thus far been sufficiently tried to be confidently relied on; yet the experiments of Dr. Garrod with animal charcoal would seem to prove, that the power which this substance has of absorbing the vegetable alkaloids, and even of separating them from their combinations, may be made available in obviating the poisonous effects of strychnia, if brought into contact with it in the stomach before enough has been absorbed to cause death. In these experiments of Dr. Garrod, when strychnia previously mixed with animal charcoal was administered to animals, they were not in the least affected by it; and a case is recorded by Mr. W. Chippendale, in which, an hour after four grains of strychnia had been taken, three or four ounces of animal charcoal, mixed with water, were injected by means of the stomach-pump, and the stomach thoroughly washed out, with the effect of saving the life of the patient, which appeared to be in imminent danger. (*Lond. Med. Times and Gaz.*, April, 1855, p. 423.) Other substances have been proposed as antidotes, on the ground that they render strychnia insoluble; but none has sufficient experience in its favour to justify a reliance on it. For an account of them the reader is referred to the U. S. Dispensatory (12th ed., p. 1356.) Among them is tannic acid, which Prof. Kurzak infers, from experiments on dogs, to be an excellent antidote, requiring, however, to be given in very large proportion, at least from 20 to 25 times as much as of the poison taken. (*Am. J. of Med. Sci.*, Jan. 1863, p. 258.) Perhaps the best emetic would be sulphate of zinc or tartar emetic, in connection with ipecacuanha.

But the evacuation of the stomach will not obviate the effects of the portion of the poison absorbed. For this purpose medicines must be resorted to calculated to diminish irritation of the spinal nervous centres. Opium, conium, camphor, chloroform, ether, and alcohol have been employed, and each with asserted advantage. Considerable doses are required; as the susceptibility to the narcotic influence seems to be diminished, as in tetanus, by the violence of the nervous derangement. One of these medicines, or some combination of them should be exhibited after the stomach has been emptied; and they may even be exhibited by the rectum during the use of emetic measures, with the exception perhaps of opium, which might tend to retard or prevent vomiting. In the *Boston Medical and Surgical Journal* (li. 476), Dr. J. H. Tewksbury, of Portland, Maine, records two cases in which camphor appears, to have been employed successfully without other measures, two fluidrachms of the saturated tincture having been given by the stomach in one case; while in the other, in which the patient could not swallow, the same preparation was injected into the rectum, and the patient at the same time immersed in a warm camphor bath. It is probable, however, that, in these cases, the camphor merely moderated symptoms which would not have proved fatal; for Dr. J. E. Thompson, in repeated experiments with dogs, found that the tincture of camphor was quite unavailing to obviate the fatal effects of the poison. (*Ibid.*, liii. 163.) Subsequently, however, Prof. Rochester, of Buffalo, N. Y., has reported two successful cases, in which he ascribes the result to the camphor used.

(*Buffalo Med. Journ.*, March, 1856.) In the *Medical and Surgical Reporter* (Nov. 18, 1865, p. 339), a case is recorded in which severe poisoning from strychnia yielded to half a pint of strong gin, exhibited in divided, but quickly repeated doses. Dr. Dresbach, of Tiffin, Ohio, relates a case in the *Western Lancet* for February, 1850, in which the most alarming symptoms, caused by swallowing three grains of strychnia, were completely relieved in fifteen minutes by two drachms of chloroform administered by the mouth Within a few years, inhalation of chloroform has been much used in poisoning by this alkaloid, and with encouraging success; many cases having recovered under its use. It very much relieves the pain and spasm, and to a considerable extent counteracts the effects of the poison, often preventing a fatal issue, until time has been allowed for the elimination of the strychnia by the kidneys. It should never be permitted to supersede the evacuation of the stomach by emetics or the stomach-pump, or the use of any substance which may be supposed to act as a proper antidote to the strychnia. The inhalation of ether, however, would be preferable, if found to produce the same effect, as it is not liable, like chloroform, to act as a fatal poison. Tobacco has also been employed with supposed success. The infusion should be given by enema. One instance, however, is recorded, in which it was exhibited by the stomach, so as to produce excessive vomiting, and with complete success. (*Braithwaite's Retrospect*, No. 46, p. 185.) M. Cl. Bernard recommends the use of woorari, which, besides contributing to relieve the spasms, favours the elimination of the poison by its stimulant influence on the various emunctories, especially the kidneys. (*Arch. Gén.*, Août, 1865, p. 203.) Aconite also is thought to be antagonistic to strychnia, and has acted successfully as an antidote in experiments on dogs. (Dr. Woaks, *British Med. Journ.*, Oct. 26, 1861, quoted in *Am. J. of Med. Sci.*, Jan. 1862, p. 276.)

2. *Mode of Operating.*

Nux vomica and its preparations are locally somewhat irritant; but not powerfully so.

There can be no doubt that the active matter is absorbed, and operates through the circulation. This is proved by an experiment of Vernière, who found that, when a ligature was applied around the leg of an animal so as to check the flow of blood in the veins, but not in the arteries, and extract of nux vomica was introduced into a wound in the foot, blood taken from the vein proceeding from the wound towards the ligature, and injected into the veins of another animal, caused the death of the latter with the characteristic symptoms of poisoning by this drug. The same inference may be drawn from the facts, that strychnia produces its peculiar constitutional effects, to whatever part capable of absorption it may be applied, and that the rapidity with which these effects occur is proportionate to the facility of absorption in the part. Thus, in contact with the lungs, it operates more quickly than when swallowed, and in the stomach more quickly than when applied to the skin. Dr. Christison killed a dog in two minutes by the injection of one-sixth of a grain in alcoholic solution into the cavity of the chest. Inserted into a wound it operates still more quickly; and, when injected into the veins, its effects are almost instantaneous. In all these instances, too, the effects are identical; proving that, in all, the blood is the vehicle by which the poison is conveyed to the part affected. Besides, Dr. A. I. Spence, of Edinburgh, has proved by experiment that strychnia is wholly unable to act by means simply of nervous communication. (*Ed. Med. Journ.*, July, 1866, p. 45.)

The medicine, when absorbed, has not been found to produce any change in the blood itself; and the phenomena of its action evince that its influence is exerted mainly at least upon the solid tissues. Upon these it seems to operate, in very small doses, as a moderate stimulus of the tonic character, closely resembling the simple bitters in the modification of the functions it induces. But it may be inferred, from its effects in larger doses, that even this tonic influence is exerted specially upon the nervous centres; and important therapeutic inferences may be deduced from this view of its action.

When given so as to produce the peculiar effects above enumerated, all the phenomena go to show that it is mainly upon the nervous centres of the spinal marrow, including the medulla oblongata, that the medicine operates. The functions of the brain are often wholly unimpaired, even when the spasms are frightfully violent; and the division of the spinal marrow near the occiput, or even the decapitation of the animal, does not prevent them. That it is not upon the muscles directly that the medicine acts may be inferred from their simultaneous contraction, and simultaneous relaxation, showing that the influence modifying their condition flows from a common source; and this can only be in the nervous centres which preside over them. Besides, Matteucci observed that, after death from strychnia, the muscles could be made to contract by the direct application to them of an electric current, but refused to respond to the same stimulus applied to their nerves; the latter having been exhausted of their excitability by the stimulus of the poison, while that of the former remained unimpaired. Another fact confirmatory of the special spinal influence of nux vomica, is the almost exact resemblance of its poisonous phenomena to those of tetanus, which is generally admitted to have its essential seat in the spinal marrow.

But what is the nature of the action thus shown to have its seat in the medulla spinalis? It appears to me obviously to be merely an excessive excitement, or, in other words, irritation of the nervous centres of this structure, extended no doubt thence to the nerves proceeding from them. The first effect is to exalt the sensitiveness of these centres. Hence, even before the spasmodic movements commence spontaneously, they may often be induced by the slightest impressions upon the surface, such as would ordinarily produce no effect. An increase of the stimulus irritates the centres into excessive action, without the aid of any additional exciting cause; and the characteristic spasms now occur with a violence proportioned to the central irritation. But in this, as in all other cases of over-excitement, the excitability itself is more or less rapidly exhausted; and, if death be not produced by the interference of the spasms with some vital function, there follows a condition of greater or less prostration of the spinal power, and consequently of depression in the functions dependent upon it. There is reason to believe that death is not always induced by the rigid immovability of the respiratory muscles, rendering breathing impossible, and thereby inducing asphyxia; for it has been found that respiration, artificially sustained, does not prevent the fatal consequences of poisoning with nux vomica. The exhaustion of the whole medulla oblongata by its over-excitement will explain the result. It has been conjectured that among the causes of death may be a direct influence of the poison on the heart, either causing a spasmodic contraction of that organ, or exhausting its excitability through previous stimulation. In support of this opinion, an experiment of M. Briquet may be adduced, who, having injected extract of nux vomica into the veins of a dog, observed the first effect to be considerably to elevate the hæmadynameter of Poiseuille, which subsequently fell lower and lower until death, indicating first an augmentation of the heart's force, and afterwards a reduction with exhaustion of its excitability. After death, the heart could not be excited to contraction. (Briquet, *Trait. Thérap. du Quinquina*, p. 87.) It may be that there is a conjoint excitant action upon the respiratory nervous centres and the heart, followed by a conjoint failure of power in both. It has been supposed that the sympathetic nervous centres are affected in like manner with those of the spinal marrow; but we have no sufficient evidence upon this point. That the nerves conveying the spinal influence to the muscles participate in the irritation and subsequent depression or exhaustion of the centres, would seem to be shown by the experiment of Matteucci before referred to, which proves that at least they lose the susceptibility to galvanic influence, while the muscles themselves remain sensible to it.

It is probable that the influence of nux vomica extends to the whole spinal marrow, including the medulla oblongata; for there is no muscle in the body, supplied from that source, which is not liable to be thrown by it into spasm.

Some suppose that the medicine acts on the cerebellum; and it has been noticed, by several observers, that this structure occasionally exhibits post-mortem evidences of having suffered in cases of poisoning. With those who believe that the cerebellum is the special seat of the sexual propensities, the excitation of the genital organs which has been occasionally noticed under the influence of nux vomica, will afford further proof of the correctness of this supposition.

Though the cerebral lobes are seldom affected by this agent, and perhaps never by a direct influence, yet the sensorial region at its base often participates in the irritation, as shown by the frequent itching and tingling sensations experienced, and the occasional occurrence of irregularities of sight and hearing, contraction or dilatation of the pupil, etc. These may be owing either to a direct action of the medicine, or, what is quite as probable, to a radiation of the original and direct spinal irritation from the medulla oblongata to the contiguous parts of the cerebrum.

3. *Therapeutic Application.*

Nux vomica has long been used as a medicine in India, and was described by the early Arabian writers, by whom it was made known to modern Europe. The name is not appropriate; for in ordinary doses the medicine is not apt to irritate the stomach, and, when given largely, seldom vomits, and could never be given with propriety in reference to an emetic effect.

The bean of St. Ignatius, though supposed by some to be the nux vomica of Serapion, was probably first made known in Europe after the discovery and settlement of the Philippine Islands, where the tree producing it is indigenous, and the seeds were used as a medicine by the natives. It was from their supposed value in the treatment of intermittent fever, and various other complaints, that the Jesuit missionaries to those islands were induced to honour the medicine with the name of the founder of their order.

Both nux vomica and the bean of St. Ignatius have, at various times, been used in numerous complaints, but, it must be confessed, rather empirically. Intermittent fever, the plague, gout, rheumatism, cholera, diarrhœa, dysentery, colic, constipation, worms in the bowels, the poisonous effects of snake-bites, scorbutic ulcers, insanity, hypochondriasis, hysteria, epilepsy, chorea, hydrophobia, neuralgia, hemicrania, palsy, and impotence are among the affections in which one or the other, or both of these medicines have been recommended. Better acquainted than our predecessors with their mode of operating, we can now prescribe them more intelligently, and with more accurate discrimination.

It will be remembered that the medicine is in small doses simply tonic, though probably with a special tendency to the nervous centres, and, more largely given, acts with great energy upon the spinal marrow, and to a certain extent also on the base of the brain, stimulating both the sensitive and motor functions. Hence arise two distinct indications for its use, one as a tonic in local or general debility, particularly when the nervous functions are involved; and the other as a direct stimulant of the nervous centres in cases of loss of sensation or the power of motion, or of both, in other words, in paralytic affections. Under these two heads will be arranged the practical remarks which are to follow.

1. *Use as a Tonic.* As a mere stimulant to the stomach, in *ordinary dyspepsia*, though probably equally efficient with the simple bitters, nux vomica has no advantage over them, while any accidental abuse of it would be attended with inconveniences to which they are not liable. Hence they should, as a general rule, be preferably employed in this complaint. But, when there is reason to think that, from want of due nervous influence, the muscular coat of the stomach is unable to perform efficiently its share in the process of digestion, nux vomica may be resorted to with the hope of special benefit. In nervous disorder of the gastric sensibility, connected with debility of stomach, it is decidedly indicated, and has been found highly beneficial. Hence its use in *pyrosis*, and that most painful affection denominated *gastralgia* or *gastrodynia.*

Upon the same principles exactly it may be employed in bowel complaints. In *constipation* dependent on torpor of the peristaltic muscles, it proves often of great service, especially in connection with tonic laxatives, such as rhubarb or aloes. In *obstinate flatulence* from the same cause, it would probably be among our most efficient remedies. We now and then meet with cases of excessive accumulation of flatus, amounting to tympanites, especially in debilitated states of the system, and in nervous persons, and wholly independent of any discoverable lesion, which resist all ordinary remedies. Some of these may depend on a certain laxity or torpor of the muscular coat, and would be very likely to yield to nux vomica. When the flatulence is attended with copious discharge of air, whether from the stomach or bowels, it may possibly arise from an extrication of gas from the mucous tissue itself, owing to insufficient innervation; and here too the remedy is indicated. In *enteralgia* or *neuralgic pains* of the bowels, connected as this often is with debility of the parts, nux vomica has been used advantageously; as also in *colica pictonum*, and in *pure nervous colic* independent of the poison of lead. The remedy has been recommended in *diarrhœa* and in *dysentery*, having been employed in the latter complaint particularly by the German physicians, some of whom speak highly in its favour. These complaints are sometimes connected with a relaxation of the bowels, in which a defect of innervation is probably concerned, permitting an excess of secretion from the flaccid vessels, or deranging the due relation between the contents of the bowels and the expulsive power. In such cases the medicine may sometimes prove useful; but, as a general rule, little good can be expected from it in these complaints, and it would probably often do harm by adding to the existing irritation of the mucous membrane.

The medicine has been little used in complaints of the chest; but M. Homolle has recently recommended it in the asthmatic paroxysm, and in suffocative catarrh, believing that, in both these affections, the difficulty lies in a want of proper contractility of the bronchial tubes and perhaps the air-vesicles, and that nux vomica operates by restoring this contractility. (*Ann. de Thérap.* par Bouchardat, 1854, p. 18.) Though not disposed to admit the pathological view of M. Homolle, I am quite willing to hope that the therapeutic advantages claimed for the remedy may prove well founded on future trial. If nux vomica does good in these complaints, it is probably, in asthma, by so affecting the nervous centres as to overcome the existing spasm of the tubes, and in the suffocative catarrh, by giving increased tone to the mucous membrane, and thereby checking the excess of secretion poured out from the relaxed vessels.

In *defect of the generative function,* M. Trousseau was inclined to make a trial of nux vomica, from having observed its effects in producing erections, and exciting the venereal propensity. He has found it useful in *impotence* in both sexes. (*Trait. de Thérap.*, 4e ed., i. 714.) It has also been employed with supposed advantage in *spermatorrhœa.*

In *general nervous debility,* manifested by tremulousness, and unconnected with positive cerebral lesion, and particularly when dependent on previous excesses, as from intemperate drinking, abuse of opium, or excess in sexual indulgences, good may be expected from nux vomica in supporting the nervous functions, while the patient is endeavouring to regain health by abstinence from the cause. Any apparent good which might arise from it, without an abandonment of the indulgences referred to, must be merely temporary, and might indeed do harm by still further exhausting the excitability of the centres.

In chronic states of debility connected with the various cachexiæ, as in *atonic gout, scrofula, atonic dropsy,* etc., good may result from the use of nux vomica as of most other tonics; but, unless a special indication exist in some functional defect of nervous power, it would be better to trust the case to medicines less liable to produce serious injury if abused. It has been recommended in albuminuria. (*Ann. de Thérap.*, 1863, p. 65.)

The asserted efficacy of the medicine in different forms of nervous disease, not paralytic, must be referred to the same tonic influence over the nervous centres, either directly stimulating them to a more energetic exercise of their function, or strengthening them against irritating influences calculated to throw them into disorder. *Spasmodic asthma* has already been referred to. The remedy is asserted to have proved effectual in *neuralgia* in the face, and may be employed against this affection wherever seated, whether externally or internally, with some hope of benefit. In *hysteria, chorea,* and *epilepsy* it was long since used, but attracted little attention until recently revived as a remedy in the two latter of these complaints. M. Trousseau, and MM. Fouilhoux and Rougier, about the year 1841, simultaneously announced the great efficiency of this medicine in *chorea;* and since that period it has come to be one of the remedies most relied on in this affection among the French physicians. (Trousseau et Pidoux, *Traité de Thérap.*, 4e ed., i. 715.) In chorea, the involuntary movements are not dependent on excess of action in the nervous centres, but upon irregularity of action, which is often connected with debility. It may, therefore, be readily understood how a medicine may prove efficient in its cure, by elevating the powers and actions of these centres. But it is not so easy to explain the asserted usefulness of nux vomica in *epilepsy.* Bayle speaks of it as having been used advantageously in this disease; and in the *N. Y. Medical Times* for April, 1855 (iv. 229), Dr. Elisha Harris has reported several cases, in which it appears to have acted very favourably. As the epileptic irritation is in the brain, while nux vomica acts specially on the spinal marrow, we can conceive that the remedy may prove useful by a revulsive influence from the former to the latter; but great care should be taken, before using it, to ascertain that the system is not plethoric, and, as a cerebral irritation superadded to that already existing might result in serious consequences, to begin with it very cautiously, lest it might, as it sometimes exceptionally does, act upon the brain. A case of epilepsy is recorded in which paralysis and death followed the use of strychnia. (Pereira, *Mat. Med.*, 3d ed., p. 1492.) *Headache, mental dejection, hypochondriacal feelings and notions, and general or local uneasiness of a nervous character*, when connected with general debility, may be treated with nux vomica with a reasonable hope of benefit. Perhaps the asserted usefulness of the medicine in bronchocele, may be traced to its action on the nerve-centres.

2. *Use as a Spinal and Sensorial Stimulant.* M. Fouquier, a French physician, was the first who regularly employed nux vomica in the treatment of *palsy.* He was very naturally led to this application of the medicine by the consideration of its physiological operation, as shown by its effects as a poison, and fully developed and established by the experiments of Magendie and others on inferior animals. In palsy there is a loss of the power of voluntary motion. One of the most striking effects of nux vomica is muscular contraction. It seemed a very fair inference that the medicine would prove useful in the disease. On trial it was found to be so in many instances, and nux vomica is now an established remedy in paralytic affections.

A curious circumstance in the treatment of paralysis by nux vomica is, that the first effects of the medicine are felt in the paralyzed part. It is in this that the muscular twitchings, the electric-like shocks, the formication, tingling, etc., characteristic of its action, are in general first experienced, especially in cases which are to end favourably. I know not how better to explain this curious fact than by supposing that each portion of the system, when under its ordinary healthful influences, is best able to resist disturbing causes; and that consequently the nervous centres which preside over the unparalyzed parts, being in the healthy state, are less readily thrown into disorder by contact with the medicine circulating with the blood, than the diseased nervous centres corresponding with the external seat of paralysis. Of course, this explanation implies that the diseased centres are only functionally affected; for, if disorganized, they become either insensible, or sensible only in an abnormal way, to the action of the medicine; and the fact is that, in cases of the latter kind, that is, when the nervous centres are organically affected, the paralyzed limb is not apt to exhibit this peculiarity, and the disease is not likely to yield to the remedy. It may, therefore, be regarded as an unfavourable sign, in reference to the remedial influence of nux vomica in palsy, when the effects referred to are displayed first in the sound parts, and little or not at all in the diseased.

But, though nux vomica was found to possess unquestionable powers over many cases of palsy, experience soon demonstrated that there were also many which were in no degree benefited by it, and that it sometimes proved positively injurious. This is what might have been anticipated from a consideration of the ordinary causes of palsy, and the mode of action of the medicine. In most paralytic affections the real seat of disease is in the nervous centres of the paralyzed part, or in the course of the connecting nerves; and this disease is very often of an organic character, that is, such as deranges or destroys the structure of the part affected. Most frequently it is hemorrhagic or inflammatory. Now to expect to restore to its healthy function, by the stimulant influence of nux vomica, a nerve or a nervous centre, already actively congested, or positively inflamed, or lacerated by effused blood, would be in the highest degree unreasonable. What might rationally be expected, under such circumstances, would be an increase of the inflammation or of the hemorrhage, and consequently a confirmation of the paralysis. When palsy, therefore, follows hemorrhage within the encephalon or spinal column, or attends inflammation of the cerebral substance or the medulla spinalis, nux vomica and its preparations should be scrupulously avoided, until the immediate effects of the injury shall have been remedied, and the nervous tissue have been restored as nearly as possible to its normal organic condition. Being now merely enfeebled, and unable to perform its function in consequence of this feebleness, all that is needed is a stimulus calculated to rouse it into action; and such a stimulus is happily afforded in the nux vomica. In the palsies, whether hemiplegic, paraplegic, or local, which are believed to originate in inflammation or hemorrhage, or other organic mischief, ample time should be allowed for the subsidence of the inflammation under suitable appliances, or for the absorption or isolation of the effused blood, and the repair of the injury inflicted by it, or for the removal of whatever other disorganizing condition may exist, before recourse is had to nux vomica. There can be no doubt that injury has often accrued from a neglect of this caution. Weeks or months, and sometimes many months, must be allowed to pass before the remedy is used. Hemorrhage generally requires a longer delay than acute inflammation, because a longer time is requisite to repair the mischief done. In hemiplegia following hemorrhagic apoplexy, it will in most cases be prudent to wait from four to six months, or even longer. When, moreover, under these circumstances, the medicine is begun with, the smallest doses should be first prescribed, and a careful watch kept so as to note the first sign of injury, and when it is presented, to suspend the remedy for a time. How far a complete restoration of the palsied part is to be accomplished in these cases of organic affection, depends upon the degree of permanent injury which the nervous tissue has suffered. When it recovers without injury, but merely debilitated, the palsy may be cured; but in very many instances there is only a partial restoration, and consequently only a partial relief of the paralyzed part.

Hemiplegia yields much less frequently and less completely to nux vomica than paraplegia; chiefly, in all probability, because the former, connected as it generally is with disease of the brain, is much more frequently dependent on a destructive, and often irreparable hemorrhage, than the latter, which, proceeding usually from disease of the spinal marrow, where hemorrhage is less common, is more apt to be a result of inflammation, or other curable affection. There is, however, another reason why cerebral palsy yields less readily to nux vomica than spinal. It is upon the spinal medulla that the remedy specially acts; and, even when the cerebral centres are sound, though debilitated, they may be without the circle of its influence, and thus remain unaffected by it. But even in paraplegia, though, when suitably employed, it often does much good, it often also fails altogether, in consequence of the disorganized condition of the spinal marrow, from inflammation, degeneration, softening, etc., or irremovable pressure upon it, as by displaced bone, aneurisms, organized tumours, etc.

Though nux vomica acts most powerfully as a stimulus to the motor power, it is by no means without influence over the sensibility or impressibility of the nervous centres, and therefore proves useful in palsy of sensation as well as in that of motion, though perhaps in an inferior degree. When the loss of sensibility depends upon a want of due power of action in the conducting fibres of the spinal marrow, it is highly probable that these are stimulated in like manner with the spinal centres by the direct influence of the medicine. Hence in paraplegia there is very generally a restoration jointly of sensibility and the power of motion. When the cause of the palsy of sensation is in the sensorial centres at the base of the brain, there is still hope of benefit from the remedy, which, as before stated, acts often with considerable energy on these centres, either directly or through emanation from the medulla oblongata. Hence, nux vomica may be used, with reasonable prospect of advantage, in exclusive palsy of sensation, whether the general sensibility is affected, or only the special senses, as of tact, taste, smell, hearing, and sight.

But the kind of palsies to which nux vomica is most appropriate are those of function merely, without organic injury of the nervous fibrils or centres. It may be very difficult to decide during life upon the nature of such cases; but when, upon the most careful examination, no source of organic mischief can be discovered or reasonably suspected, the practitioner will be quite justifiable in presuming upon its absence, and in giving at least a trial to nux vomica. *Palsy commencing with hysterical phenomena*, or of *rheumatic origin*, if persistent, may be treated in this way; and in the various forms of *lead-palsy* nux vomica is among the most efficient agents. It has also proved especially useful in *diphtheric paralysis.*

Of the varieties of palsy, as connected with the seat of the affection, little need be said. Of *hemiplegia* and *paraplegia* enough has been said in the preceding general remarks. *General palsy* too often fails to yield to any remedy; but it is among those in which nux vomica is particularly indicated; for, if obscure in its origin, it would obviously call for a trial of means calculated to stimulate the defective function; and if traceable, as it often is, to degeneration of the nervous tissue under depressing influences, it is to be remedied, if at all, by the joint influence of a tonic and of a stimulant to the enfeebled tissue, such as is exerted by the medicine under examination. In *local palsies*, such as those dependent on injuries, the use of the remedy is to be governed by the same principles as in the other forms. There are a few of these local affections which require particular notice.

Retention of urine from palsy of the bladder, and *incontinence of urine* from a similar condition of the sphincter muscles, are frequently treated with advantage by nux vomica or its preparations; and it is among the most efficacious remedies in the nocturnal incontinence of children, which frequently depends upon debility of these muscles.

In *prolapsus ani* in children, depending on debility of the sphincter ani, it would seem to be indicated. M. Duchaussoy reports a very obstinate case, in a child of eleven years, in which a complete cure was effected, in less than a week, by the daily application of about one-fourth of a grain of strychnia upon blistered surfaces near the anus (*Archives Gén. de Méd.*, Septemb. 1853, p. 328); and a somewhat similar case is recorded in the *London Medical Times and Gazette* (Nov. 1854, p. 521). Might not the remedy be prescribed with equal effect by the stomach, or in the form of injection with or without a little laudanum? Of course, if given in this way, the dose must be diminished. It has been used successfully by the injection of the solution into the subcutaneous tissue near the anus.

Functional aphonia is another example of muscular relaxation or paralysis in which nux vomica is clearly indicated.

Loss of taste, or *of smell*, *deafness*, and *amaurosis*, when purely nervous or functional, may possibly be benefited by the medicine; and the practitioner would always be justified in employing it in these affections: nor, even when they may have originated in active congestion, hemorrhage, or inflammation, provided that all acute symptoms have ceased, and time has been allowed for the repair of the injury inflicted, need the remedy be withheld, though it would probably prove less efficacious than in the functional cases. In *amaurosis* it has been used locally with great supposed advantage, being sprinkled, in the form of powdered strychnia, upon blistered surfaces upon the temples, as near the seat of the complaint as possible. Experience has not fully confirmed the sanguine hopes that were at one time entertained of its efficacy; but, with the caution above given, in relation to any possibly existing organic disorder, it may be used with great propriety either endermically, or by the stomach. Used hypodermically, by injection into the supra-orbital areolar tissue, the solution has proved successful in a case under the care of M. Fréminau. (*Med. T. and Gaz.*, Jan. 21, 1865.)

4. *Administration.*

In reference to the administration of nux vomica and its preparations, a few preliminary observations regarding certain peculiarities in the operation of the remedy are necessary, in order properly to regulate its exhibition.

In the first place, it has been often noticed that the system becomes less rapidly habituated to this remedy than to most others, and that consequently it is not requisite, in order to maintain a given impression, to go on increasing the dose, as is necessary with the narcotics. After it has been ascertained how much is required to produce the characteristic effects, the dose may often be continued without augmentation for a long time. I have had patients for several weeks, if not for months, under the use of strychnia, without being able to increase the dose, unless at the risk of inducing troublesome muscular contractions. Nevertheless, it is probably only in degree that nux vomica differs from other medicines in this respect; and if, after having given evidence of its action, it should at length cease to do so, the dose should be cautiously increased up to the amount requisite for sensible effect.

It occasionally happens that, instead of becoming less susceptible to the influence of the medicine with its continued use, the system is apparently more so, and the same doses cannot be borne as at first. This can be explained, without the necessity of considering nux vomica as an absolute exception to the otherwise almost universal rule. In the event referred to, the medicine may be conceived to have induced a positive irritation of the spinal marrow, perhaps in consequence of an existing predisposition, which irritation, having thus been set on foot by it, will continue altogether independently of its further influence, just as if it had been induced by cold, which does sometimes give rise to a similar condition, as in idiopathic tetanus. This irritation may continue for several days, giving rise to phenomena similar to those produced by the medicine, which seems therefore to sustain its action for a long period, though really at the time quite inoperative. In this condition, a further dose would aggravate the irritation, and seem, therefore, to be operating on an increased susceptibility; whereas the susceptibility might remain unaltered, or possibly even be lessened. The occasional result, therefore, above referred to, must be considered as exceptional, and by no means authorizing the conclusion, as a law of the action of nux vomica, that the longer it is given the greater is the susceptibility to its action.

A second very important consideration is the vast difference of susceptibility to its influence in different individuals. In this respect, though not quite peculiar, for there are several substances of which the same fact holds true, and some even to a greater extent than nux vomica, yet it differs so much from ordinary medicines that the greatest caution is requisite in regulating the dose. I have known a lady to be thrown into violent and even alarming spasms, almost threatening suffocation, by one-twelfth of a grain of strychnia; and instances have already been referred to of death from fifteen grains of the powder, and three grains of the extract of nux vomica; while Pereira once gave to a patient a grain and a half of the alkaloid, which was repeated several times, before the symptoms indicating that the system was affected came on. Though he began with smaller quantities, and gradually increased to that mentioned, and although no serious consequences ensued in the case, yet he states that subsequent experience had convinced him that so large a dose was dangerous. With our present knowledge of the action of this medicine, I do not think that a practitioner would be justifiable in administering such quantities, however cautiously they may have been reached. I have noticed the extreme susceptibility, above referred to, most frequently in nervous females.

A third point worthy of attention is the question whether nux vomica is cumulative; that is, whether, after having been given for some time in repeated doses, at the ordinary intervals, without any apparent effect, it can ever break forth suddenly with the full influence of the accumulated doses, and with danger to life. It has generally been thought not to be so; and no danger has been apprehended upon this score. But a case has been recorded by Dr. Pereira, which shows that the use of it is not so exempt from this danger as had been supposed. Strychnia was given to a man first in the dose of one-eighth of a grain, then of one-quarter, and finally of half a grain, in each instance being repeated three times a day, and the last dose was continued many days without perceptible effect. At length he was seized suddenly with violent spasms, and died with asphyxia in a very short time. (*Mat. Med.*, 3d ed., p. 1497.) Uncombined strychnia is of extremely slight solubility in cold water, while in acidulated water it is readily dissolved. It might happen that acid in the primæ viæ should be wanting for a time, and the strychnia thus remain undissolved and accumulating; but at length the gastric juice, reacquiring its normal acidity, might dissolve the whole at once, and enable it to be absorbed. The effects in the above case may thus be conjecturally explained. The lesson deducible from it is never to venture upon so large a dose; as present impunity, even though lasting for many days during the administration of the medicine, affords no certain guarantee against ultimate danger.

From all that has been stated above it is to be inferred that, in using any of the forms of nux vomica, we should begin with a very small dose, especially in persons of great nervous irritability, as nervous females and young children, and increase by minute increments, and at intervals not shorter than a day or two, until we have ascertained the active dose, and then increase no further, but rather fall back somewhat, or suspend for a time, especially if the symptoms should be of a rather decided character. If the first dose produce observable effect, it should not be repeated till these effects have ceased, and then in diminished amount. In no case should the quantity be increased, however cautiously the augmentation may be conducted, to an amount adequate to the destruction of life in ordinary persons.

When the medicine is administered as a tonic simply, it may be pushed, with the precautions just mentioned, to the point of observable effect on the system, and then diminished, so as to be maintained just within that point.

The following are the different forms which may be resorted to for exhibition.

The Powder. Nux vomica is not readily reduced to fine powder, and from this cause, as well as from its extremely bitter taste, and its uncertainty as regards strength, is seldom administered in that form. The dose is five grains three times a day, to be gradually increased till its effects are produced; but in no case should it be pushed beyond fifty grains; and it would be better to stop short at twenty or thirty grains. The dose of the bean of St. Ignatius should not be more than one-third that of nux vomica. Either of these may be given in pill if deemed advisable.

ALCOHOLIC EXTRACT.—*Extractum Nucis Vomicæ.* U. S. 1850, *Br.*—*Extractum Nucis Vomicæ Alcoholicum.* U. S.—This contains all the virtues of the seeds. It is more convenient and efficacious than the powder, but like it is liable to the objection of inequality of strength. If the estimate of M. Recluz as to the average product obtained from the seeds is to be relied on, it is about twelve times as strong as the powder. The dose is from half a grain to two grains, and in no case should exceed four or five grains. In persons of an irritable nervous constitution, it would be best to begin with the smallest quantity mentioned. For a child from four to eight years old, the commencing dose may be one-eighth or one-sixth of a grain, which should not be increased beyond one, or at the furthest, two grains. At first, one or two doses may be given daily, which should be increased to three or four doses, before augmenting the size of each. The extract is most conveniently given in the form of pill.

ALCOHOLIC EXTRACT OF IGNATIA. — *Extractum Ignatiæ Alcoholicum*, U. S. — Under the name of *ignatia amara*, an extract of the bean of St. Ignatius was a few years since used empirically or popularly to a considerable extent. It is needless to say that so powerful a medicine should never be tampered with, and never employed unless under proper medical supervision. The revisers of the U. S. Pharmacopœia for the present edition, sensible of this inconvenience, have introduced a formula for the extract under the name at the head of this paragraph. It is prepared by first forming a tincture by percolation and then evaporating the tincture to dryness. The dose is stated at from half a grain to a grain and a half, three times a day; but, considering the relative richness in strychnia of the nux vomica and the bean of St. Ignatius, it would probably be safer to commence with a dose not exceeding at most one-half of that of the extract of the former medicine.

TINCTURE. — *Tinctura Nucis Vomicæ.* U. S. — This is seldom used internally, on account of its excessive bitterness, while it has no advantage in relation to equability of strength over the powder or extract. If the nux vomica be completely exhausted by the alcohol, the quantity equivalent to five grains of the powder will be twenty minims. This, therefore, may be considered as the proper commencing dose for an adult. As hitherto stated in most books, the dose is too small for effect, unless it may be as a tonic. The tincture is chiefly employed externally, by friction or as an embrocation to paralyzed parts. It may be conveniently diluted with the camphorated tincture of soap, or used as an addition to the liniment of ammonia.

STRYCHNIA. *U. S., Br.* — All that has been said of the effects of nux vomica on the system, and of its uses as a medicine, may be considered as applying also to strychnia. When pure it has the advantage over the powder, extract, or tincture, of perfect uniformity of strength. The only objection to it is the extreme danger from over-doses, which therefore should be avoided with the greatest care.

Strychnia is usually procured from the bean of St. Ignatius, in consequence of its greater richness in this principle than nux vomica. The seeds, properly comminuted, are treated with acidulated water till exhausted; the liquid thus obtained is precipitated by means of lime; the precipitate is treated with alcohol, which dissolves out the alkaloid; the alcohol is distilled off from the tincture; the residue is dissolved with sulphuric acid; the solution having been purified by animal charcoal, is filtered, evaporated, and crystallized; and the resulting sulphate is redissolved and precipitated by ammonia. As thus obtained, the strychnia contains some brucia; from which it may be freed by repeated crystallization from its alcoholic solution; the brucia being left behind in the mother liquor, in consequence of its greater solubility in cold alcohol. The only disadvantage of brucia is that it renders the preparation weaker in proportion to the quantity present. A little of it does no harm.

Though crystallizable from its alcoholic solution, and sometimes crystalline as sold in the shops, strychnia is more frequently in the form of a white powder, inodorous, excessively bitter, fusible by heat, but not volatilizable without decomposition, entirely dissipated when thrown on red-hot iron, almost insoluble in cold water, soluble in 2000 parts of boiling water, freely soluble in officinal alcohol when hot, but much less so when cold, and very sparingly soluble in ether. It may be known, in connection with the above properties, by yielding a violet colour, when a minute proportion of solution of bichromate of potassa is added to a solution of the strychnia in concentrated sulphuric acid. If reddened by nitric acid, it may be assumed to contain brucia. With the acids it forms salts, most of which are soluble in water and crystallizable. The watery solution of salt of strychnia is precipitated by the alkalies and their carbonates, and by tannic acid; but the precipitated matter is medicinally active. Perhaps, however, the most delicate test of strychnia is the physiological test of Dr. Marshall Hall; its powerful effect, namely, in producing tetanic spasms in the frog. One of these animals, put into a liquid containing but an extremely small proportion of strychnia, say one-fiftieth of a grain in the fluidounce, speedily becomes affected with violent tetanic spasms, and perishes. (See *Med. and Surg. Reporter*, June 24, 1865, p. 85.)

To a very considerable degree, strychnia has superseded nux vomica and its other preparations. Being one of the most violent poisons known, it requires to be prescribed and administered with the greatest caution. Many instances of death are upon record, arising from carelessness in the dispensing or use of it.

The *commencing dose* of strychnia, when quite pure, should not exceed the sixteenth or twelfth of a grain; and, in patients of irritable nervous systems, it would be best to commence with the twenty-fourth of a grain. This dose may be repeated twice or three times a day, and gradually increased, if necessary, in order to obtain its sensible effects. As death has resulted from half a grain, repeated two or three times a day for several days, it would be best never to allow the augmentation of the dose to reach this point. But, as the strychnia of the shops is often impure, larger doses than those mentioned are often necessary for effect. Less than one-sixth of a grain of commercial strychnia will often produce an effect; but, as the strength is generally known only by trial, the dose of any untried parcel should not at first exceed that of the pure alkaloid. A very important caution, in prescribing strychnia, arises out of its variable degree of purity as kept in the shops. When the parcel is changed, unless the one first used is of known purity, the dose should be diminished to a point at which no possible injury could accrue, whatever might be the strength of the new parcel. For children from four to eight years old, the commencing dose should not exceed the thirtieth or fortieth of a grain. The best form of administration is in pill, which may be made with the crumb of bread, or the conserve of roses. Should no effect proceed from ordinary doses, the patient should take a little acidulated drink, as diluted acetic acid, in order to favour its solubility in the stomach; or, should the bitterness not be objectionable, the strychnia may be exhibited in solution, made by slowly dropping into the water in which it is suspended enough acetic, diluted sulphuric, or muriatic acid, to render the liquid clear. For children, the solution may sometimes be advantageously incorporated with syrup, so as to make the dose a teaspoonful.

One of the salts of strychnia, as the *muriate*, *sulphate*, *acetate*, or *nitrate*, may be substituted for the uncombined alkaloid. The only advantage of the salts is their solubility, so that they may be used in the pilular form, without the necessity, in any case, of following them with an acid. The dose is the same as that of strychnia.

The *Sulphate of Strychnia* (STRYCHNIÆ SULPHAS, *U. S.*) is directed, in the U. S. Pharmacopœia, to be prepared by mixing the alkaloid with distilled water, gently heating the mixture, and gradually adding diluted sulphuric acid until the strychnia is neutralized and dissolved. The liquid, now filtered and evaporated, yields the sulphate in crystals. The salt is in prismatic crystals, colourless and inodorous, but extremely bitter, readily dissolved by water, sparingly by alcohol, and not at all by ether. It melts with heat, and at a high heat is completely dissipated. The dose is the same as that of uncombined strychnia.

Strychnia, or one of its salts, may be used externally by sprinkling it, in the form of powder, upon a surface denuded of the cuticle. The solubility of the salts here gives them an advantage. The quantity first used, if the preparation be pure, should not exceed half a grain of the strychnia, or a quarter of a grain of one of the salts. It may be applied also to the sound skin in the vicinity of the palsied part, in the way of embrocation; the strychnia or one of its salts being incorporated previously with glycerin or oleic acid. One part of strychnia, with a minute quantity of diluted sulphuric acid (a drop or two for each grain), may be rubbed up with fifty parts of glycerin, and a teaspoonful of the mixture rubbed over the paralyzed limb, or along the spine in chorea. (*Journ. de Pharm. et de Chim.*, xxvi. 65, 91, and 303.) Dr. I. Hays, of Philadelphia, has used, with advantage, a solution of acetate of strychnia, dropped into the eye, in order to produce contraction of the pupil, and to excite the muscle of accommodation. (*Am. Journ. of Med. Sci.*, July, 1863, p. 266) Strychnia has been used hypodermically in amaurosis and prolapsus ani, and might be similarly employed in other local paralytic affections; the quantity injected at first not exceeding one-half the commencing dose by the mouth.

BRUCIA.—This alkaloid is extracted in the same manner as strychnia, and accompanies it in the first steps of the process, but is in great measure separated on the crystallization of the latter from the alcoholic solution, remaining behind in the mother liquors in consequence of its much greater solubility in alcohol when cold. Still, it is with difficulty entirely separated from strychnia, and is very apt to contain it as existing in commerce. It should be procured in the state of crystals. It is bitter, but less so than strychnia, and much more soluble in water and cold alcohol. It is reddened by nitric acid. Its claims to be considered as a distinct principle have been denied; and Dr. Fuss supposes it to be a compound of strychnia and resin. It forms, however, distinct salts with the acids, which are for the most part soluble and crystallizable.

From experiments of Magendie, Andral, and others, brucia is believed to be identical in its effects with strychnia, only much weaker. M. Lepelletier, however, who had ample opportunities of noting its effects in the hospital practice of M. Bricheteau, though he considers its physiological action analogous to that of the stronger alkaloid, has yet found it to be in some respects peculiar. Thus, the fingers and great toe are rapidly extended and flexed, sometimes even producing a friction sound in the articular surfaces, but are never affected with that tetanic rigidity so characteristic of the action of strychnia. Moreover, the muscles of the jaws, pharynx, and œsophagus, which participate in the spasmodic effects of the latter principle, remain almost always unaffected under the influence of brucia. On the organs of generation, however, brucia acts with considerable energy. But, according to M. Lepelletier, the great advantage of brucia is its comparative safety; and, if it be true that it does not produce the tetanic rigidity, as he asserts, the danger of asphyxia, at least from the immovability of the respiratory muscles, is avoided. M. Bricheteau, though he has employed brucia for a very long time, has never known serious consequences to result. It may be used for the same purposes as strychnia, its great advantage being, according to the author just cited, its comparative safety. He considers its influence over the generative organs, in connection with its entire harmlessness, a peculiar recommendation. But, as it is often combined with strychnia, it is indispensable, in order to obtain due results, that attention should be paid to its purity, and that it should be employed only when in the crystalline state. (*Ann. de Thérap.*, 1852, p. 50, etc.)

Statements vary as to the comparative strength of brucia. Andral considers it as having only one-twenty-fourth of the strength of pure strychnia, Magendie the one-twelfth. M. Lepelletier gives the commencing dose of it, when quite pure, at two centigrammes (about one-third of a troy grain), to be increased progressively to five, ten, twenty centigrammes (about three grains troy), or even more, if necessary to obtain its physiological effect. (*Ibid.*, p. 62.)

LANE MEDICAL LIBRARY

To avoid fine, this book should be returned on or before the date last stamped below.

From the Press of J. B. Lippincott & Co.

MILITARY MEDICAL AND SURGICAL ESSAYS.

Prepared for the United States Sanitary Commission. Edited by WILLIAM A. HAMMOND, M.D. 1 vol. 8vo. $5.00.

CONTENTS.—I. Military Hygiene and Therapeutics, by Alfred Post, M.D., and William H. Van Buren, M.D. II. Control and Prevention of Infectious Diseases, by Elisha Harris, M.D. III. Quinine as a Prophylactic against Malarious Diseases, by William H. Van Buren, M.D. IV. Vaccination in Armies, by F. G. Smith, M.D., and Alfred Stille, M.D. V. Rules for Preserving the Health of the Soldiers, by W. H. Van Buren. VI. Scurvy, by William A. Hammond, M.D. VII. Miasmatic Fever, by John T. Metcalfe, M.D. VIII. Continued Fever, by J. Baxter Uph
IX. Yellow Fever, by John T. Metc
X. Pneumonia, by Austin Flint,
Dysentery, by Alfred Stille, M.D.
and Anæsthetics, by Valentine M
XIII. Hemorrhage from Wounds,
Best Means for arresting it, by
Mott, M.D. XIV. Treatment of Fr
Military Surgery, by John H. Pack
XV. Amputations, by Stephen Sm
XVI. The Excision of Joints for
Cause, by R. M. Hodges, M.D. X
real Diseases, by Freeman J. Bums

LEIDY'S ANATOMY

HUMAN ANATOMY. An Elem
Book for Students. Elegantly
By Joseph Leidy, M.D., Profess
tomy in the University of Pe
8vo, sheep. $5.00.

GUNSHOT WOUNDS

GUNSHOT WOUNDS AND OTH
RIES OF THE NERVES. By
MITCHELL, M.D., GEORGE
HOUSE, M.D., and W. W. K
Acting Assistant Surgeons U.
Paper, $1.00. Cloth, $1.50.

GERHARD ON THE C

THE DIAGNOSIS, PATHOLO
TREATMENT OF THE DISEAS
CHEST. By W. W. GERHARD,
Edition, revised and enlarged.
Cloth, $3.25. Sheep, $3.75.

HAMMOND'S VENEREAL DISEASES.

LECTURES ON VENEREAL DISEASES.
By WILLIAM A. HAMMOND, M.D. 1 vol.
8vo. $3.00.

POWER'S ANATOMY OF THE ARTERIES.

ANATOMY OF THE ARTERIES OF THE
HUMAN BODY. With a Descriptive Ana
tomy of the Heart. By JOHN HATCH
POWER, M.D. 12mo. Elegantly illustrated
$2.50.

UNITED STATES PHARMACOPŒIA

THE PHARMACOPŒIA OF THE UNITE
STATES OF AMERICA. Fourth Decennia

U121
W89
v.1
1868

Wood, Geaorge Bacon
Treatise on therapeutics ...

NAME 9009

DATE DU

ATTIC

ATTIC